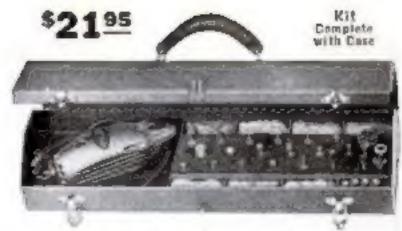




The Drill Press attachment converts the famous Heavy Duty Hand Grinder into a sensitive type Drill Press that is ideal for the Model Maker or Master Craftsman. Drilling, routing, veining and many other operations may be accomplished with ease and precision. Its rigid and practical design and the large, machined and ground working surfaces of the table and base insure production of speedy and accurate work -and there is plenty of power in the Hand Grinder so you don't need to worry about stalling.



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CONTENTS FOR FEBRUARY 1940

Mile-a-Minute Model Cars	61
Toothpick Engineering	70
Oddities from Ocean Jungles	73
Getting in Shape for Skiing	90
Roof-Top Trap Stores Sun's Heat	96
600 Miles on Hour	101
Merry-Go-Round Observatory	108
Finds Treasure in Peat Moss	.112
Making of an Army Flyer	120
Ghosts of the Wild West	128
How Good Is a Used Car?	132

Features and Departments

OUR READERS SAY
IDEAS FOR HOME OWNERS32
THE MAN WITH THE NET
NEW HOUSEHOLD APPLIANCES
POPULAR SCIENCE QUESTION BEE
UN-NATURAL HISTORY141
GUS WILSON'S MODEL GARAGE
AMATEUR PHOTOGRAPHY167
NATIONAL HOMEWORKSHOP GUILD
ADVENTURES WITH YOUR MICROSCOPE
HOME-LABORATORY CHEMISTRY
RADIO DEPARTMENT
USEFUL HINTS FOR MOTORISTS



Planning to ski this winter? If so, you can prepare your muscles for the shock with home exercises pictured on page 90

AUTOMOBILES

Car Testa Reveal Static Secrets	82
Ski Rack Fits on Running Board	107
Latch for Overhead Garage Door	220
Choke-Rod Return Spring	220
Wall Mark Shows Backing Limit	220
Separate Hot-Water-Heater Pump	222
Rubber Strips Plug Tire Casings	222
Drilling Holes in Radiator Hose	224
Hydrometer Serves as Spray Gun	224
Temporary Hose Repair	224

AVIATION

Fire	Fighters	Use !	Para	chute		83
	(Cor	tinue	d on	page	4)	

THE HOME WORKSHOP begins on page 145

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CONTENTS [Continued]

Planes on Noses Save Space 106	Walking Stick Becomes Tripod 126
Airplane Is Cosmic-Ray Laboratory 107	
	Movie-Editing Desk Set 127
HELPS FOR HOME OWNERS	Rack Holds Single Film 127
Fertilizer Shot into Soil 32	Album (on Transportation 197
Kit Has Tools for Home Repairs 32	Thicke in Prince Dell Eller Tanks 107
Wall-Board Joint Hides Nails	Contama for Manning Photo Decord 100
Fire Alarm for the Home 34	Marie Common Wheeled on Doller 170
Questions from Home Owners 36	Transpirer Chamber with Dies Light 170
The state of the s	Roller Covered with Blotter 170
HOUSEHOLD AIDS	Cut-Outs Prop Up Book Ends
Holder for Toothbrushes 138	Blocking Part of a Negative 171
	Total octobra in a committee Continue and
Ferris-Wheel Shoe Rack 138	prop deres an sample connector and
Stand Makes Kneeling Easier	actioner and a series compilition and
Slicing Plate Serves Bausages	
Dial Sets Speed of Mixer	Troublip Burrace for 2 order at the
This Flatiron Is Round 139	
	Catalita Date 101 Table-10p Discussion Box
Pot Holds Tea and Water 139	Cover recon 113 po Fice of Dastannia 200
Hanger for Small Belongings 139	Diaphragm Fades Movie Scenes 236
NEW INVENTIONS	
	UNUSUAL FACTS AND IDEAS
Visor Snaps on Ski Cap	All Gui Delivers Concrete
Toy Submarine Dives and Rises 69	Wires His Campus for Sound 84
Fireproof Gloves for Camp and Home 69	Numbers Mark Soldiers in Training 85
Television Eye Shows Sun's Corona 81	Diver Feeds Fish 86
Crane Car Speeds Up Track Laying 82	Novel Christmas-Tree Village 87
Novel Manicure-Set Holder 84	Gas-Station Men Wear Roller Skates. 88
Kit for Carving Plastics 84	A diddle- 17 meet A cae tableat at the legitimes. Co
Spray for Protecting Trees	How To Get Fleas from a Grizzly 89
Handle Opens New Knife 85	Troop Marka Milestone For Transmiss
Cone Speaker in Toy Phonograph 94	He a Never Caught Without a Lenen. Do
Light Motor for Bicycle 99	
Spillproof Necktie Rack 100	Headlines Are Made to Order 100
Keeps Poison Gas from Food	Novel Trap Electrocutes Ants 100 Service Breaks In New Shoes
Self-Cleaning Comb Curls Hair 111	Aid Shows Refrigerator Savings 105
Traveling Case for Bottles	Targets Train Antitank Gunners 106
Portable Water-Filtering Plant 117	Big Retort Built for Movie 110
Loops Hold Ski-Cap Visor 118	Pits Conceal Antitank Guns 111
Knife Is Holder for Key 119	Title Control Statistics Company
Storage Flash-Light Cell 125	Total a state of the state of t
	Pastiton r inten recope artition r intellim 170
PHOTOGRAPHY	Cows Get Radiation Treatment 118
	Hides Secret of "Death Ray" 117
Midget Photoflash Bulbs 88	Smoke Tests Guide Sailboat Design 118
Films Form Bookless Library	Bike Gives Second-Story Ride 119
Camera Catches Shells' Flight 116	Gasproof Canary Carrier 125
Meter for Color Film 126	His Roof Is a Rock. 136
Miniature Contact Printer, 126	(Continued on page 6)

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CONTENTS [Continued]

CRAFTWORK

Jig-Sawed Archer Guards Tray	153
Small Leaf-and-Blossom Tray	161
How to Make Shepherds' Pipes	162
Neckerchief Slides for Scouts	166
Tiny Chair Serves as Sewing Box	176
Large Medal Displayed in Plaque	177
Disney's Model of Pinocchio	180
Colorful Little Desk Clock	182
Hang-Up Anchor-Shaped Lamp	192
A Dinner Gong from Brass Pipe	195
Ski Jumper Ornamenta Snow Suit	229

HINTS FOR THE HANDYMAN

Cork Utilized as a Shaker Top	153
Lubricating Soldering-Iron Tip	153
Ideas for the Shipshape Home	154
Set-Up for Sharpening Skates	156
Slot Holds Screws on Driver	
Keeping Down Dust in the Shop	156
Clock Closes Bedroom Window	
Ski Carriers Fastened to Auto	158
Shoe-Polishing Case in Wall	160
Reading Star Charts at Night	
Chair Tip Acts as Hook Latch	
Removing Printing from Plastics	166
Pencil Holds Thread for Mending	166
Electric Iron Kept in Closet	
Lumber Rack for Small Truck	
Safe Grip on Bits of Solder	
Rubber Band Protects Socket	
Knurled Roller Protects Check	
Giant Dividers Measure Acreage	
Heat Renews Old Carbon Paper	
Metal Dust Visor for Register	
Wooden Handle Attached to File	178
Pliers Force Brads into Frame	
Skagway Scow Scoots on Snow	178
Drawing Board for Stenciling	
Cork on Bit Acts as a Gauge	179
Hand Tools for Special Purposes	186
Acid Solution Cleans Filter	
Fiber Washers Cut from Fuses	
Simple Outfit for Ice Fishing	
New Inner Soles for Work Shoes	
Altering Outside Window Shades	
Old Ribbon Acts as a Stamp Pad	
Wire Wrapping for Soldering Iron	195
Substitute for Hollow Rivets	
Well-Boring Outfit Costs Little	
Old Tire Keeps Gate Closed	212
Hints on Better Jig-Sawing	
Tire Casing Reduces Vibration	
Photo Reflector Acts as Oven	213
Shop Sayings of Old Bill	228

HOME LABORATORY

Stones under the Microscope	206
Weights Hold Cover Glasses Down	208
Oil Refinery for Home Chemists	
(Continued on page 8)	



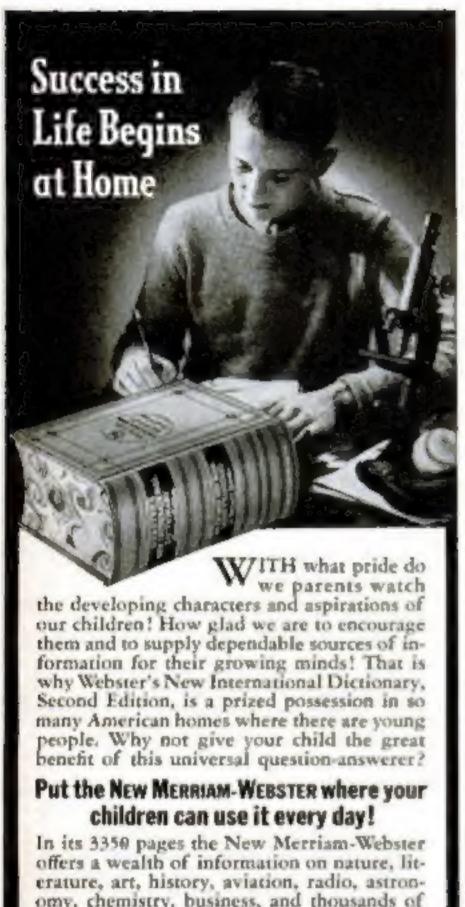


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CONTENTS [Cantinued]

MODELS

Fans Run Big Model Railway	85
Pickaback Cuts Aerial Capers	94
Scale Model of a Bandwagon	99
Kits Trace Railroad History	107
Tiny Electromagnet Loads Train	-
Pelican Carved in Three Poses	194
Scale Model of "Unitwin Vega"	196
Simple Plane for Model Makers	202

NEW SHOP IDEAS

191 199 200 201 201 201 201
200 201 201 201 201 201
201 201 201 201 201
201 201 201
$\frac{201}{201}$
201
DOD
202
203
203
204
204
205
205
205
212
212
212
2 2 2 2 2 2 2 2

SHOP DATA FILE

Finish for Dresser Drawers	161
Lighting Photo Copy Work.	172
How to Sharpen Auger Bits	178
Number of Wires in Conduits	179
Speeds of Woodworking Machines	190
Selection of Grinding Wheels	205

WOODWORKING

All-Purpose Family Runabout	146
Cutting Delicate Inlays	152
Rope-of-India Smoking Stand	152
Shaper Cutters Used for Turning	153
Portable Case for Drafting Kit	157
Three Hanging Bookshelves	159
Make-Up Chest for a Girl's Room	174
Drawers Improve Tool Boxes	176
Table-Tennis Table with Pipe Legs	191
Pony Toy Operated by Pedals	193
Record Player Placed in Box	202

RADIO

Round-the-World Radio	214
Volume-Control Replacement Kit	218
New Tester Works Automatically	218
Air-Spaced Trimmer Condenser	218
Radio and Phonograph in Tables	219
Blinker Tells if Battery Is On	219
Radio Laboratory on Wheels	219

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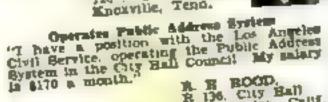
J. E. Smith, President National Radio Institute Established In years

Trained These h

"I repaired many Radio sets when I was on my tenth lesson I made \$600 in a year and a half and I have made an average of \$10 to \$20 a week-but spore 1 me e half and I have the spare 1 me to \$20 a week | Just spare 1 me 10HN JERRY

Denver, C; Makes \$50 to \$60 n Week "I am making between \$50 and \$60 a week after all expenses are paid, and I am git-ting all the Radio work I can take care of, thanks to N.R.L.

R W SPANOLER 1261 S Gay St. Knoxville, Tenn.



R 136, City Ball Los Angeles, Calif.

Radio is a young, growing field with a future. It offers many good pay spare time and full time job opportunities. And you don't have to give up your present job. so away from home, or spend a lot of money to become a Hadio Technician. I train you right at home in your spare time

Joba Like These So to Mon Who Know Radio

Radio broadcasting stations employ engineers, operators, technicians and pay well for trained men. Radio manufacturers employ testers, inspectors, foremen, servicemen in good pay jobs with opportunities for advancement. Radio jobbers and dealers employ installation and servicemen. Many Radio Technicians open their own Radio sales and repair businesses and make \$30. \$40. \$50 a week. Others hold their regular jobs and make \$5 to \$10 a week fixing Radios in spare time. Automobile, police, nyintion, commercial Radio, loudspeaker systems, electronic devices, are newer fields offering good opportunities to qualified men. And my Course Includes Television, which pronders to open many good jobs soon.

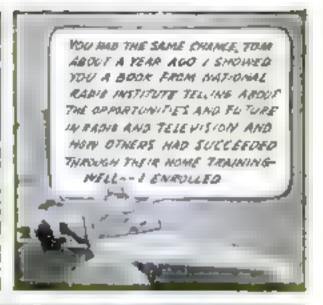
Why Mans Sindio Tochnicions Make \$20, \$40, \$50 a Week

Radio is already one of the country's large industries even though it is still young and growing. The arrival of Television, the use of Radio principles in industry, are but a few of many recent Radio developments. More than \$8,000,000 homes have one or more Radios. There are more Radios than telephones. Every year



the property of the state of th









millions of Radios get out of date and are replaced. Millions more need new tubes, repairs, etc. Over 3,000,000 auto Radios are in use and thousands more are being sold every day. In every branch Radio is offering more opportunities—opportunities for which I give you the required knowledge of Radio at bothe in your spare time. Yes, the few hundred \$20, \$40, \$50 a week jobs of 30 years ago have grown to thousands.

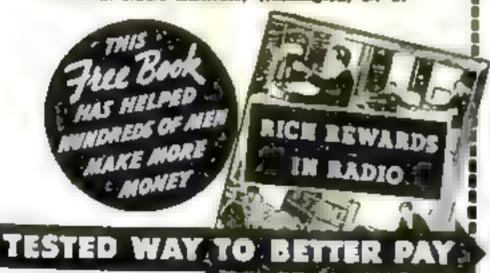
Many Make \$8, \$10 a Week Extra In Spare Time While Learning

The day you enroll. I start sending you Extra Money Job Sheets which start showing you how to do Radio repair jobs. Throughout your Course I send plans and directions which have helped many make \$200 to \$300 a year in spare time while learning. I send special Radio equipment to conduct experiments and build circuits. This 30-50 training method makes learning at home interesting, fascinating, practical.

Find Out What Radio Offers You

Act today Mail coupon for my 44-page book, "Rich Rewards in Radio," It points out Radio's spare time and full time opportunities and those coming in Television; tells about my course in Radio and Television; shows many letters from men I trained, telling what they are doing and earning. Read my money back agreement. Find out what Radio offers you. Mail coupon in envelope or paste on penny postcard—NOW.

J. E. SMITH, President, Dept. SBP3, Nutional Radio Institute, Washington, D. C.



Also Bive You This Professional Servicing Instrument

Here is the type of instrument successful Radio Technicians use —an All-Wave Set Bervicing Ining everything necessary to meas-

strument. It contains everything necessary to measure A.C. and D.C. voltages and current; to check resistances, adjust and align any set, old or new. It estimates your needs for professional servicing after you graduate—can help you make extra money fixing sets while learning.

GET THE FACTS; MAIL THIS COUPON NOW!

THIS COUPON GOOD FOR ONE FREE COPY OF MY BOOK!

J. E. SMITH, President, Dept. 08P3, National Radio Institute, Washington, D. C.

Dear Mr. Smith; Bend me FREE, without obligation your 6: page book ' Rich Rewards in Radio'' which points out spare time and full time opportunities in Radio. those coming in Television, and explains your 50 M method of training men at home in spare time to be Radio Technicians. (Write Plainly)

NAME

AGE

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ADDRESS

CITY

STATE

Our Readers Say

\$100 IN PRIZES

How would you like to write one short letter that would bring you \$50 in cash? Here's your chance. All you have to do is write 300 words or less telling us what article, feature, or department in this issue of Popular SCIENCE MONTHLY you liked most and why. For the four best letters received before February 1, 1940, Popular Sci-ENCE MONTHLY will award a total of \$100 in cash prizes. The writer of the letter which in the opinion of the judges is the best will receive the first prize of \$50. The second best letter will be awarded \$25, the third best \$15, and the fourth best \$10. The editors of Popular Science Monthly will judge the letters, and their decisions will be final. In case of a tie, each tying contestant will be awarded the prize tied for. Address your letter to the Contest Editor, Popular Science Monthly, 353 Fourth Avenue, New York, N. Y. No. entries will be returned, and all will become the property of Popular Sci-ENCE MONTHLY.

Some Long-Overdue Praise for an Unsung Hero

Ir's been said many times that the electromagnet is the most important contribution of science to modern living. Without it, for example, we'd have no electric generators no electric lights, radios, nor trains, few internal-combustion engines, in fact virtually none of the basic everyday conveniences we accept everywhere we turn. I'm writing, however, to offer humble gratitude to some unsung hero who devised another important scientific device that helps us get along no end. It's something that is used in two places in my furnace, once each in my household hot-water heater, electric iron, waffle iron, toaster, and refrigerator, and also in the cooling system and carburstor of my car. That's nine of them without even trying. The amount of work they save me is great, and all of them do a better job than I could if I spent twenty-four hours a day trying. Of course, there are other modern conveniences that we carelessly overlook, but this is an outstanding one. Know what I'm referring to? I wonder how many of your readers do.-W. D., Buffalo, N. Y.

Soppers of the World Arisel Down With This Sissy Stuff!

AN INTERESTING plea came recently from the secretary of the American Bakers Association to lift the stigma from the socially frowned-upon act of "sopping" Sopping.

YEAH, THEN WE'LL HAVE A PLOKE OF BOOKS ON HOW TO SOP, LIKE THE BALONEY ON WINE, DRINKING!



he defines as "the practice of using a piece of bread to sop up gravy and the juices of vegetables and fruits." Long before eating utensils were invented, sopping was in good taste. As a sopper from way back, I feel that it is time for the soppers of the world to arise and do some sneering themselves at the tra-

dition breakers who first brought this noble and delightful pleasure to disrepute. When so-called polite society first eschewed sopping, it wasn't long before dunking and picking up the drumstick in your fingers went by the board, too. Nowadays, anyone who practices these eating habits does so at his own risk. Come on! Let's be realists and enjoy what's good to eat with the abandon of those wholesome hedonists the French, and with one accord dip our bread in the gravy, sop up all we can, eat it, and like it!—B. G., Boston, Mass.

Here's One To Keep You Lying Awake Nights

Being, to the best of my knowledge, out of range of a television transmitter, I of course

do not own a television receiving set. All I know about televising I've learned from the pages of your fine magazine. What I know of actual reception is second-handed to me from a friend who lives near New York. He has a receiver, and tells me occasionally by letter of some of the programs he gets. But what I'm writing

WE'LL LET YOU KNOW WHEN WE GET THROUGH DINNER



about really is this: If a television camera were aimed so that its field of view just took in the front of a television receiver a few

(Continued on page 14)

Promotion Begins at Home

Pay Raises Depend Largely on What You Do in Your SPARE Time

If you are an average high school graduate, the average man with college grade vocational training earns \$25 a week MORE than you!

YESTERDAY-

in 1906 . . . Meny doctors then procticing were not even high school graduates. High School had not been required at the time they entered







in 1908... Very few even thought of doing to college, unless to enter one of "the learned professions." The number of college graduates in bustness and industry was so few that they formed practically NO COM-PETITION in the average job.



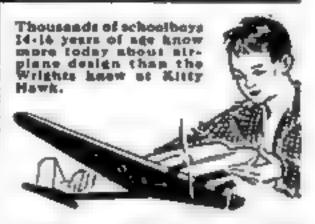
in 1900 . . . The "little red school-house" did a pretty fair job of equip-ples men and women to make their way in the world.



TODAY-



in 1946 Schools of nursing require high school graduation because most of them are conducted at college level. Progress has made modern nurses training equal or superior to that available to many old time





in 1940 . Almost exing genduated from college today, as from high school 40 years go Everywhere do in commerce, against the competition of COLLEGE GRADUATES.



Train at Home NOW for a BETTER Job TOMORROW!

Alice in Wonderland learned: "You must run as fast as you can in order to stay where you are. Toget anywhere, you must run TWICE that fast."

Jobs are like that. On your employer's time, you must work as hard as you can - as well as you can - in order to be sure of holding what you already have. To get anywhere-to win promotion—a better job—bigger pay more consideration from your employer - you must make EXTRA effort on your own time, at your own expense, on your own responsibility.

You Should Get College Grade Training Somehow, Somewhere

High school education is not enough, today If you can afford to quit work and go to rendent college or university, by all means DO SO. It will pay you. But if this avenue. of escape from playery of low pay and july monotony is CLOSED to you, write for our FREE builetin describing how much college erade vocational training you can get at home, in SPARE time, wilhout interference with present job and earning power

Write TODAY—No Obligation

American School, Chicago, is favorably known to employers everywhere for its high standards in home study. Hundreds of our graduates have won Promotion- big pay positions-in Commerce, Engineering and Professions. All vocational courses recently enlarged to help YOU win true Success in your chosen line. More than 150 educators, engineers and executives cooperated. Investigate your chances TODAY Mail combon!

J American School, Dept. 9-246, Drezel Ave. at 58th St., Chicago. Illinois

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DBusiness Management

Name

Address

Our Readers Say CONTINUED

feet away and tuned to the transmitter, what would appear on the television receiver's viewing screen? A picture of Itseif? A blank? Can anyone tell me?-S. D., Norfolk,

He Might Find It Easier To Change His Name

Why doesn't some clever fellow think up a universal code for spelling out difficult names over the telephone? It is my misfortune to have a very unusual name, and to live on an almost unpronounceable street. When I have to give my name and address over the phone, it's a matter of saying "P as in PETER, T as in TOM," and so on. Sometimes the pereon at the other end doesn't catch the "Peter" and "Tom" either. What can I do

then-spell them out? I think it would help was 6000 would a cone if everybody used the same words for this purpose. I suppose most people use PE-TER for P and TOM for T, but I can imagine a college professor saying "P as in POPO-CATEPETL, T as in TRANSUBSTANTIA-TION." Let's get together and work out a simple system for ev-



BE TORA HAME FULL OF

erybody. We could call it the "TOM, DICK. and HARRY" System .- A. N., Milwaukee, Wils.

No One Got Gypped and Everybody's Happy

IN ANSWER to R. G. N.'s problem in the November issue, no one got gypped. All ended up even, and with all their debts paid and collected. Smith knew in the first place that it was a counterfeit bill he had found, so that he lost nothing when he burned it up. -D. R. V., Dorchester, Mass.

A Darkroom is Only As Safe As Its Unsafest Safelight

Bs it dark, be it light, a darkroom is only as safe as its unsafest safelight. Thus, in answer to D.V.'s query as to what color the walls of his darkroom should be, it really makes no difference. Walls merely reflect light; they do not give off light. Thus, if no light enters the room, no harmful light can possibly be reflected from the walls. The same is true with the use of a safelight. If this is of an approved type and with no light leakage, any reflection from the walls, whether dark or white, would be unimportant. It might be well to add that most photographers, including Hollywood professionals, prefer the white walls.—A.D.C., Wenham, Mass.

He Would Put the Bearskins on the Bare Skins

Your readers seem to be very much interested in the subject of bands, and to have very definite ideas about them. Not long

ago, you published a very angry letter from a fellow who doesn't like bare-legged girl drum majors. Now I see a letter from LR N., Denver, Colo., finding fault with the new "fur coat" for covering wind instruments in cold weather. Why not settle the whole matter by putting the fur coats on the girl drum majors?

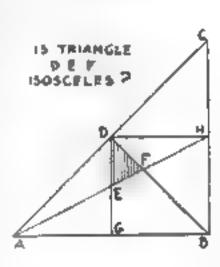


That ought to satisfy the fellow who doesn't like the bare legs, and also remove L.R.N.'s objection to muffling the horns. And it might be appreciated by the girl drum majors, too on some of these winter days when cold breezes sweep down the streets.-AME., Indianapolis, Ind

"It Seems To Be So" Never Satisfied Euclid

How about giving the geometers another

opportunity to stick their necks out? In the accompanying sketch, ABC is a rightangle isosceles triangle. Midpoint on the base AC is D, from which are constructed DG and DH parallel to CB and AB, respectively. Next, AH is constructed, It pears now to the unaided eye of the veriest child that triangle



DEF is isosceles. Is it? How do you know? Can you prove your contention, if any? -W. E., Baltimore, Md.

An Introduction to Horner. for Which He Is Grateful

May I express my gratitude for the appearance of JJM's problem about the concentric spheres, for its solution acquainted me with Horner's method of evolving the root of a numerical equation—in this case a cubic equation. Solving for the radius of the sphere from two equations, I obtained by Horner's method the figure 55.8018 for the

(Continued on page 16)



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NAME

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City.....State....

Our Readers Say KONTINUED

radius. Hence the circumference equals 350.613243549282-not being dead certain of the last few places of the decimal fraction. -M K., Canton, Ohio,

if He Turns to Page 61 His Squawk Will Be Answered

Being one of your constant readers since 1932-and I still have all the issues-I want

to voice the opinion that your magazine has had nearly perfect articles all these years. Now that 1939 is nearly over, I feel called upon to squawk loud and long because you recently had such a small article on model racing cars. How about a real write-up on the subject? In Canada I have not heard much of them



nor seen one. I am very much interested in this new sport, so how about it? Piesse tell Gus Wilson that his articles are tops with me.-L.B., Hamilton, Ontario.

But We've Yet To See the Magician Who Shows You How It's Done

To as frank with you, there is in this country a considerable number of men and women who, for one reason or another, have been interrupted in their school studies, but who are still deeply interested in mathematics. I



am one of those. The mathematical probiema in your magazine form the focal point as far as my interest is concerned. There is little satisfaction in reading a problem when one is denied the solution. It should be possible for you to furnish answers in subsequent issues. You probably do not realize the serious, dili-

gent effort that many of us put forth to solve these problems, as a matter of education and training. Even a magician shows his final result.-C.W.B., Duluth, Minn.

It's Easier for Readers To Hold and It Holds This Reader

This makes the second year I have been taking P.S.M. It is one of the finest magazines I have ever read. You should be congratulated for making the change in size. It's very much easier to read and hold than it formerly was. I wonder how many of your readers really take time to think what a wonderful institution it really is? It has articles on subjects that the public never would hear about otherwise, and so many clever ideas that it stimulates the reader into having ideas of his own.-R.P.S., Iron, Minn.

What Makes Frost Appear When the Air Isn't Freezing?

Everybody knows that frost is frozen dew. But I've noticed that frost often appears on the ground on fall and winter mornings

when thermometers indicate the temperature is well above freezing. Of course, sometimes the ground is cold enough to freeze the low-lying moisture, even though the air is not cold enough to freeze it. But this can't very well be so in the fail before the ground bas had time to lose its store of summer heat.



In fact, on a fall morning, I checked with several neighbors as to the reliability of my thermometer, which had read thirty-seven degrees F. as the sun came up across my frost-covered lawn. Each reported his thermometer had shown about the same temperature as mine at about the same time. Now I'd like some one to explain to me why the dew on the lawn froze when the temperature was above the freezing point. How about it?-A.M.J., Dayton, Ohio.

Turtles Aren't So Dumb: Remember the Hare and the Tortoise Fable

In aggant to the turtle trap that Mr. Lucas uses to catch turtles around Long Island. N.Y., the gentleman is credited with being public enemy No. 1 of snapping turtles. I wonder how long it took him to train 19,000

turtles to do the goose step in order to get HOWOY, FOLKS into the trap. Perhaps the turtles do pln wheels to untangle their long claws. I never imagined that there were 19,000 turtles on Long Island that were smart enough to know how to get around the "guide lines" and into the trap. However, it was the most interest-



ing story I've read in a long time. Some one with imagination like Frank Buck could make a lot of money with one of those turtles.—G.C., Hollis, N.Y.

MAGINE THEIR JOY WHEN THEY FOUND THEY COULD PLAY



E NOTE

Tenor Banjo

Instrument

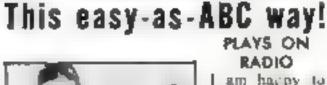
QUICKLY AT HOME

I didn t dream l could actual y searn I spray without a teacher Now when I play for people they hardly believe that I learned toplaysowe in *H S.C. Canf



SURPRISED FRIENDS

My friends are surpresed at the different pieces L con already play. I am very happy to have chosen your method of learn-Bronn, N. Y.





PLAYS ON RADIO

am happy to tel, you that fur four weeks I have been on the hir over our local radio station So thanks to your instituto a for such a wonder (a) S., Alabama.

What Instrument Would You Like to Play?

UST name your instrument and we'll show you how you can learn to play it—quickly, easily, in spare time at home, ever mind if you don't know one note of music from another o't worry about "special talent". And forset all you've ver heard about music's being hard to learn

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Every year thousands of Patents are granted. Very few, however, represent the discovery of entirety new principles. Most of them provide new methods of duting some every day thing in a better way -changes for greater efficiency, usefulness, adaptability, or beauty in some previously Patented thing. These IMPROVEMENTS are putentable if new and actually represent new inventions. These improvement Patents offer large chances for profit if commercially useful. The business world wants improved products and services.

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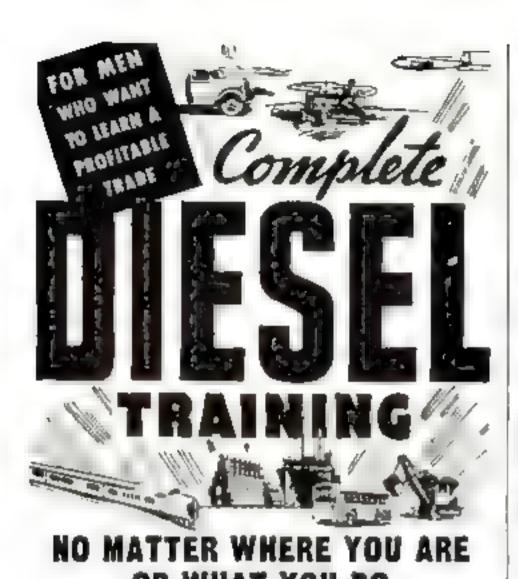
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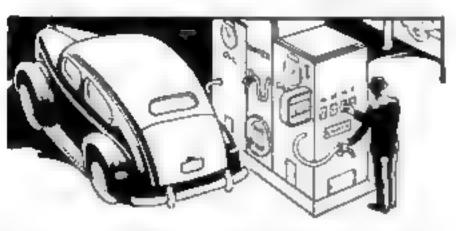
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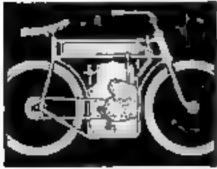
With the Inventors

ASOLINE, oil, air, water, and repair tools are all made available to motorists by an automatic, coin-operated service station invented by Peggy K. Masson, of Forest Hills, N.Y. When a motorist drives



up to the roadside unit and inserts coins in the slots provided, a supply of gasoline or oil is measured out according to the amount of money inserted. The car owner then places the connecting hose in his gas tank or oilfiller pipe, turns a lever, and the measured liquid flows out. Inserting any coin to purchase gas or oil automatically turns on the water and air supplies, which may then be used free of charge, and also unlocks a door to a compartment containing automobile and tire repair tools, each attached to a long chain . . . In A STRAIGHT ASSIGNMENT of a patent, the purchaser of a one-percent interest has as much right to use and exploit the invention as the owner of the remaining ninety-nine percent . . . WHEN A CYCLIST





PEDALS along a level or down grade on bicycle equipped with a novel hydraulic-drive attachment, he builds up a surplus store of energy in the device which can later be released to furnish additional power for increasing speed or mounting a hill. In operation, the pedal action not only drives the bicycle's rear wheel, but also operates a pump in the unit to force a

fluid into a storage chamber and compress a series of springs. The stored energy in the springs can then be released whenever the rider desires, to help drive the wheel. This is the invention of Conrad Bichi, of San Francisco, Calif. . . CONE-SHAPE PRO-JECTIONS OF RUBBER form the surface of an unusual snowless ski slide developed by Hugh F. Bethell, of Norwalk, Conn. Said to provide a surface on which skiers can exe-

cute the same maneuvers they employ on real snow. the rubber cones are molded in one piece with rubberblock bases, which are mounted on an inclined wooden or metal slide. As the akia move down across them, the flexible cones bend down, springing back into place after the ski has passed by. Water fed into a trough behind the rubber



blocks, squirts through tiny boles to lubricate the cones whenever a weighted ski passes over . . . ONLY IF PATENT OFFICIALS are convinced that the result will be an immediate investment of money and consequent employment of labor, will they consent. to examine a patent application out of its regular turn . . . A MAZE OF DRAWERS, compartments, dispensing units, holders, and grooves are built into a curious folding-leg game table invented by John G. Blaschke, of Hot Springs National Park, Ark. Sliding out of openings in three sides of the table top are half-moon holders for chips, dice, and other game accessories. A drawer is provided on the fourth side for game boards, pencils, paper, and other incidentals. Beneath ash trays at the four corners are



storage compartments for cigarettes which are automatically delivered one at a time when a sliding panel is pulled outward. The upper end of each table leg is hollowed out to accommodate a glass, which can be rest-

(Continued on page 24)

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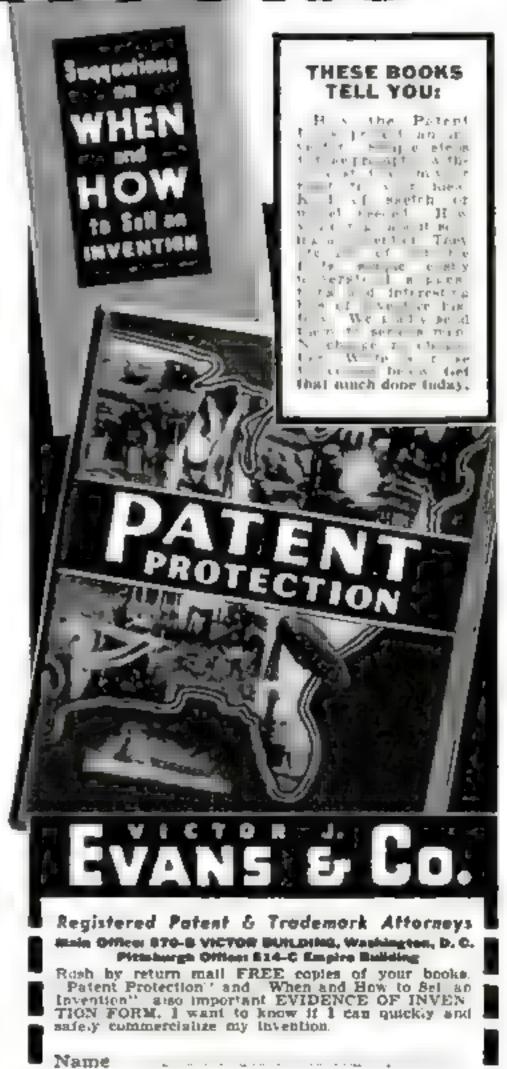
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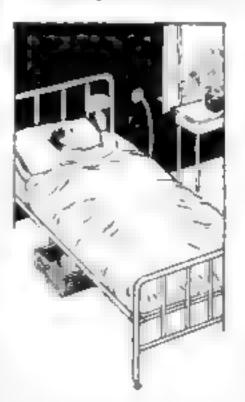
With the Inventors

(Continued from page 22)

ed on the hinged cover of the compartment when opened to a horizontal position . . . PATENT LAWS ARE BASED ON Article 1, Section 8, of the Constitution of the United States: "The Congress shall have Power To



promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." ... "ROWING" A BLED ACROSS LEVEL SNOW is possible with a novel propelling mechanism worked out by Walter Eberhardt, of Chicago, Ill. Sitting on the sled, feet forward, the rider grasps two vertical levers pivoted at the sides of the sled, and works them back and forth. This causes pointed arms to dig into the snow and push the sled forward . . . A HANDY PLACE FOR STORING various sick-room necessities is provided by an electrically operated drawer designed by Blanche Hudon, of New York City, so that it can be installed under a hospital bed. Driven by a small electric motor and rolling



on parallel tracks. the storage drawer slides out sideways when the patient touches a button at the head of the bed. The patient can then reach the contents of the opened drawer with no movement other than reaching his hand out over the side of the bed . . . A PROMINENT AU-STATES THORITY that the majority of the inventions that ultimately

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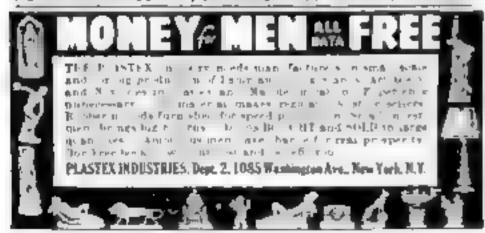
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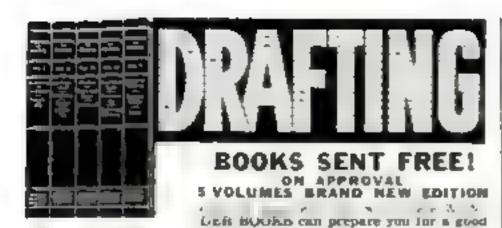
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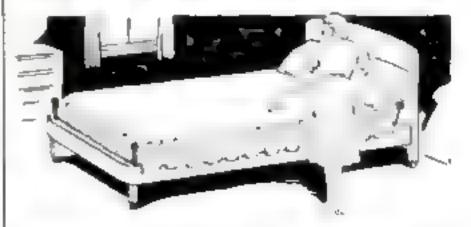
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volve around another rotating wheel that supports sets of false teeth in different styles and sizes. By manually turning the inner wheel and the masks, the dentist can make any set of teeth appear in the mouth opening of any mask

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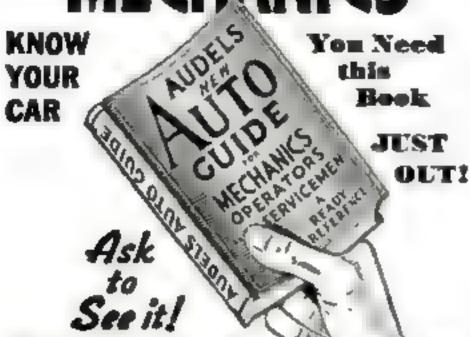
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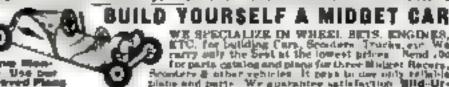


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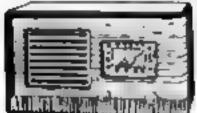
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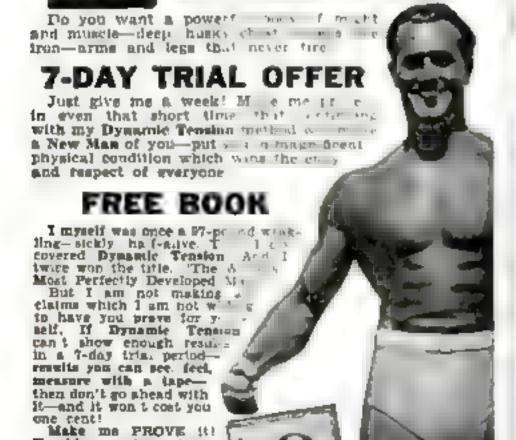
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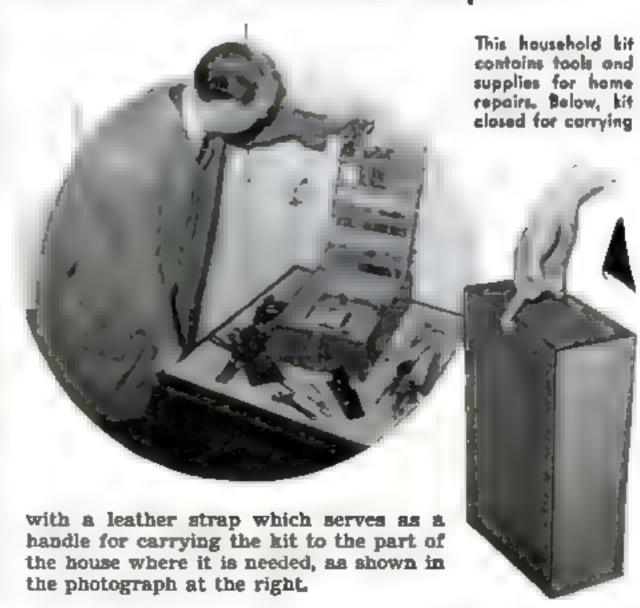
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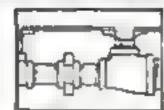
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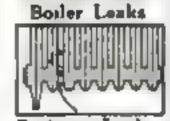
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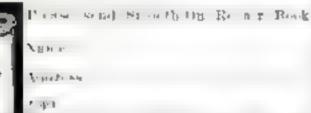




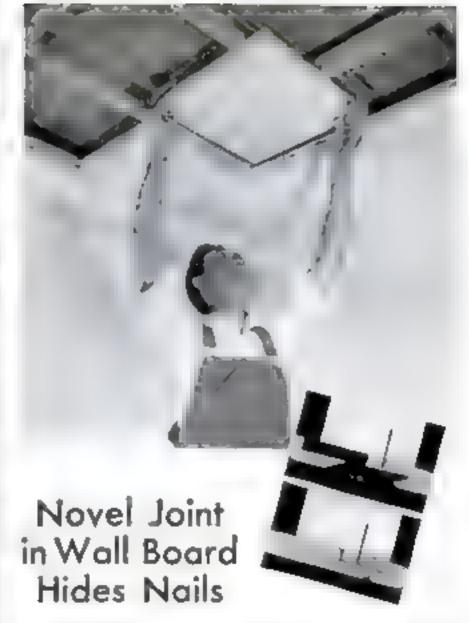


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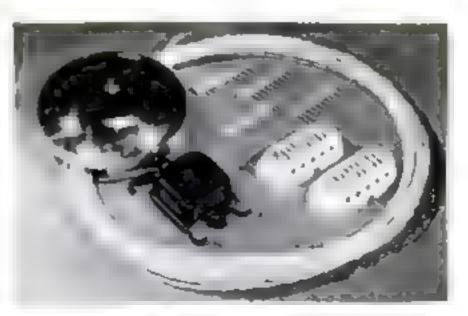




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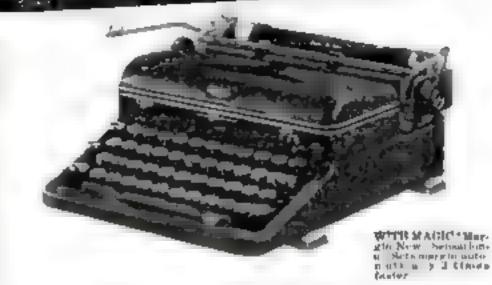


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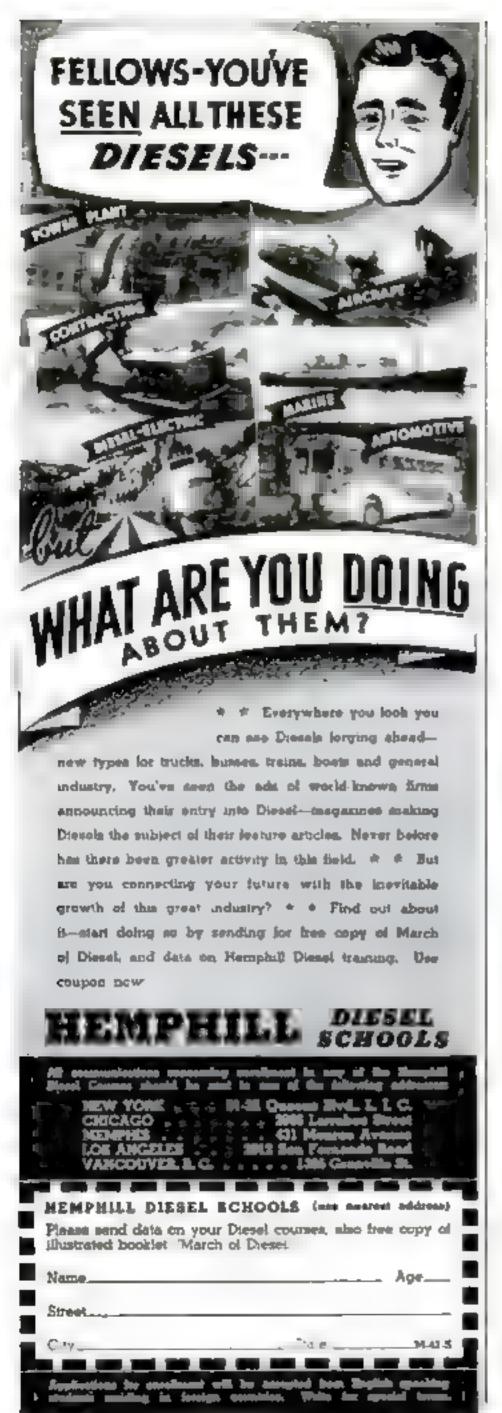
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Questions FROM HOME OWNERS

Q.—WE HAVE an upstairs bedroom floor which has been used off and on for fourteen years, and the hard pine flooring has dried out, leaving cracks between the boards. How should these be filled in? Should they be filled before or after the floor is sanded?—J. M., Meadows, Ill.

A.—IF THE cracks are not too wide, they can be filled with a mixture of sawdust and varnish. Wide cracks should be filled with strips of wood cut to fit and glued in place. There is also on the market a powdered filler which is mixed with water. The floor should be sanded before the cracks are filled, as this will remove many of the smaller imperfections. If the floor is very splintery, it would be wise to rent a floor-sanding machine. After the cracks have been filled, the floor should be given a second sanding to remove any rough spots and give the floor a smooth, finished look.

Natural Finish for White-Pine Walls

Q.—I AM building a small house with an outside wall surface of about 2,000 square feet. I plan to use white-pine boards and battens, and instead of using house paint or stain, I want to use a clear, colorless finish that will preserve the beauty of the natural wood and prevent its discoloration. What would you advise?—H. E. A., Detroit, Mich.

A.—WE SUGGEST that you use a very highgrade outside spar varnish or a high-grade marine spar. Thin the first coat with turpentine and apply over this at least two and preferably three coats of full-bodied varnish. This will darken the wood to some extent, but will give a durable finish with the beauty of natural wood, just as it does on yachts and small boats.

Painting Crumbly Plaster

N. O'D., CHILLICOTHE, OHIO. When painting a plaster wall whose surface tends to crumble, all surface powder should first be removed with a painter's duster or a large bristle brush, taking care not to mar the surface. Then apply a coat of varnish size, following this with a priming coat of flat wall paint or a mixture of half flat wall paint and half size. Finish with two or three coats of regular paint, just as you would with any other plaster wall, but do not apply it heavily.



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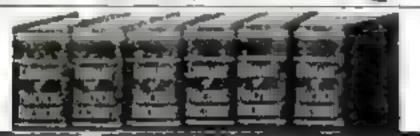
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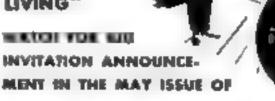
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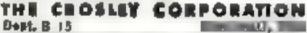
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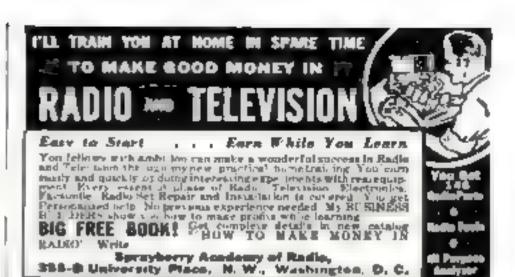
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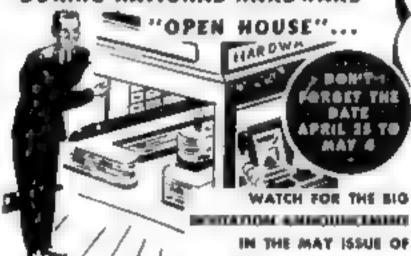
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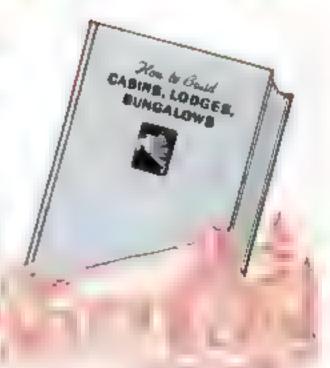
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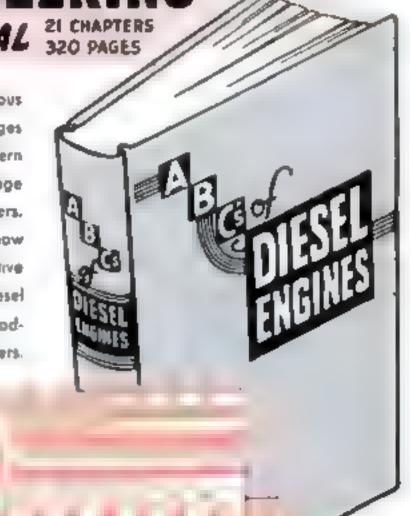
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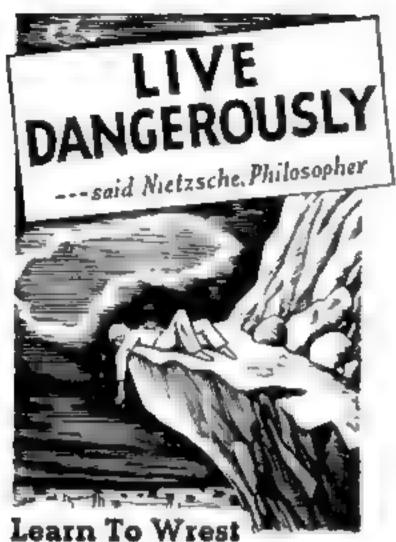
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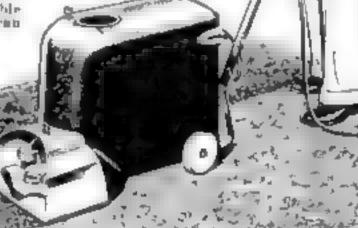
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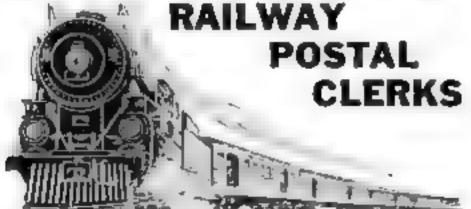
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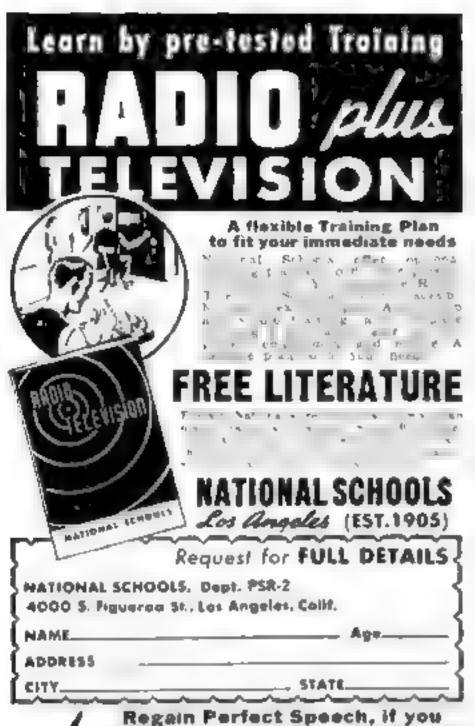
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NEWEST RACING CRAZE:

A tiny speedster flagged or it starts its race against time

Mile-A-Minute Model Cars

ILE-A-MIN-UTE midgets, tiny racing cars that whirl at dizzying speeds at the end of wire cables or on special Lilliputian speedways, form the latest

thrill sport of model makers. Hardly more than a year ago, the first races were held in California. During the intervening months,

"Filling her up," A gloss syringe is being used to put fuel in the midget gas tank

the sport has swept across the country. Both the New York World's Fair and the San Fran-

cisco Exposition featured the little machines in races against time. A national association has hundreds of members. Already



Model meets have all the fixings, even to electric timers and timing boards

N.Y., Salinas, Calif., Fresno, Calif., Mil-

waukee, Wis., and New York, N. Y. How engrossing the new hobby can become was demonstrated recently in a western city when neighbors called the police because a local enthusiast was keeping them awake most of the night tuning up his engine!

It takes but a couple of evenings to put a car together. Then come tests and trial runs, and finally the big moment—the start of a competitive race against time. Such competitions have almost as much action, excitement, color, and noise as a full-sized speedway derby. There is the bawling of loudspeakers, the flash of the starter's flag. the shrill whine of the little engines, the fumes of special fuels, the feverish activity in the repair pits.

One after the other, contestants come to the starting line. Each has three minutes to get his engine started and his car circling at the end of an airplane-cable tether. This cable, the correct length to make six circles of the course equal a quarter of a mile, is attached by means of a roller-skate-wheel pivot to a central post and to the side of the



low tires, clamped securely to the wheels, are fitted to the racing models. The average weight of the midget cars is six and a half pounds. In competitions, the main rule is that all machines must weigh one pound for every tenth of a cubic centimeter of engine displacement. Not long ago, at an indoor meet at Pottstown, Pa., one car was ruled out as under weight. Undaunted, the owner tied bits of metal and even a flat monkey wrench to the chassis, bringing the weight of his entry up to the required point, and then succeeded in turning in the second best time of the day.

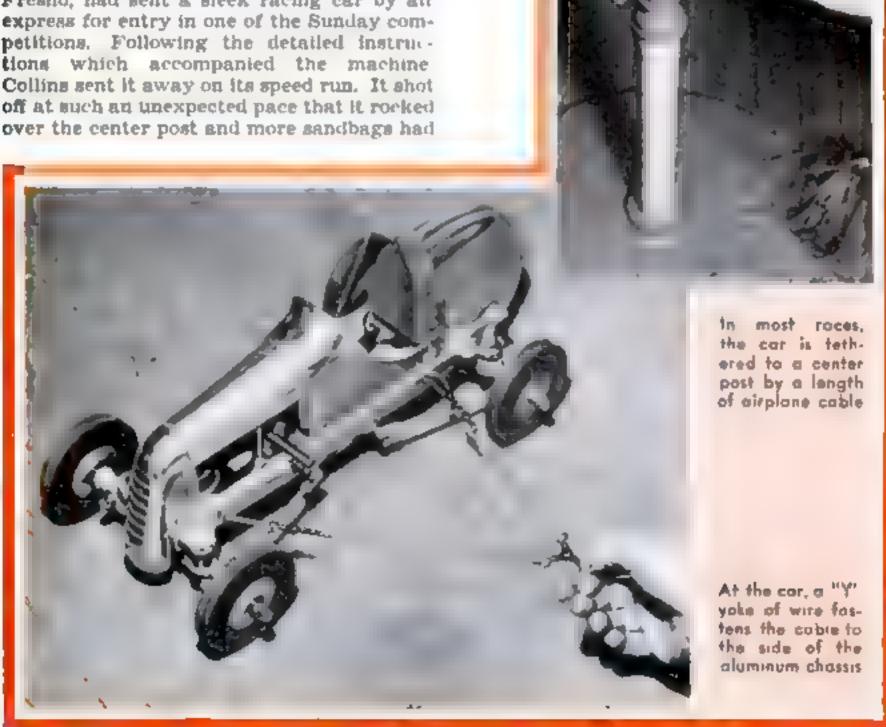
A vital factor in prize winning is getting the carburetor set just right. Early experimenters frequently soldered the carburetors directly to the engines. In speed trials, the power plants heated up and the expanding metal of the carburetor changed the delicate adjustment of the needle. By separating carburetor and motor with a short length or rubber-and-fabric hose, two Bayside, NY., enthusiasts, Art Ritter and Jerry Collins, overcame the difficulty. The hose conducts far less heat than metal does.

It was Collins, last summer, who played an important part in the most sensational run of the New York World's Fair competition. A California fan. R. E. Hulse, of Fresno, had sent a sleek racing car by air express for entry in one of the Sunday competitions. Following the detailed instructions which accompanied the machine Collins sent it away on its speed run. It shot off at such an unexpected pace that it rocked

to be piled about its base. Then the little car got away for another flying start and at the end of a quarter of a mile, it was flagged down after having attained a peak speed of fifty-five miles an hour.

"Flagged" down is technically correct, For the speeding midgets are now usually stopped by means of flags. A stiff wire extends for several inches above the body. When it strikes the cloth of the flag, it is pushed back, flipping off a toggle switch and stopping the engine. This improvement simpliftes the work of bringing the whizzing cars to a halt.

Other innovations make their appearance at almost every meet. A few weeks ago, in California, a car equipped with a Lilliputian, belt-driven supercharger, attracted wide attention. To increase the efficiency of his racer, another western enthusiast has developed a centrifugal clutch which grips





Spectators watch a contestant worm up his cor at a recent race held in New York City



Many racers are assembled from kits like that seen at the left

Little black cases house the care when owners travel to a contest



tighter as the machine builds up speed. At Pottstown, Pa., William Beaver has developed an ingeniously simple arrangement which steers his racer and keeps it from "fighting the tether" and wasting power. A spring holds the front wheels turned out, away from the central post, when the car is standing still. In motion, the pull of the cable, acting on an arm, turns the wheels inward, the degree depending upon the speed at which the machine is traveling. Thus, centrifugal force automatically keeps the little car "tracking" correctly throughout a race. In the ordinary machine, the steering wheels are permanently set in one position.

Just as individual ideas appeared in the design of the racing cars, so each pioneer had his own pet blend of fuel. Gasoline, benzine, alcohol, castor oil, and other ingredients went into these concections. One experimenter produced such a powerful mixture it blew the top off his engine. Another tried pure alcohol and soon discovered it had eaten holes in the walls of his cylinder. At present,

65

a blend of fuel and lubricant specially prepared for outboard racing motors is most popular with the midget-car racers.

Because of the initial cost of getting started in the sport, two or more enthusiasts often band together to pool expenses and share the fun. Among the most successful teams of the kind are the Dooling brothers of Los Angeles and the Ritter-Collins team of Bayside. Collins and Ritter have cleaned up most of the prizes in the East, including the three-foot trophy presented at the New York World's Fair, and Tom and Harry Dooling carried off the main prizes at the San Francisco Exposition and the coveted Matthews Trophy for the fastest mile made at the new Los Angeles miniature speedway.

This one-sixteenth-mile de luxe oval represents the last word in tracks for midget racers. There are pits for fifty contestants. The electrical timing apparatus is accurate to a hundredth of a second. A special crash fence protects the spectators, and loudspeakers broadcast the results of the PROPER

the banked wooden oval, riding on metal rails much in the manner of cars on a roller coaster. Ball-bearing guide wheels reduce friction so the speed of the cars is cut only two or three miles an hour. Twice, racers at the new track have been timed at better than mile-a-minute speeds.

A roller, spinning under the wheels of the cars at the starting line, cranks the engines, and tiny catapults shoot the machines forward at the beginning of the race. Thus, although each car is clocked individually, the four racers are bunched and the excitement is increased for the spectators.

Movie stars and Air Corps pilots, as well as ordinary citizens, have failen under the spell of the new sport. Growing lists of entries prove the popularity of this craze which combines the fascination of mechanics with the thrills of the roaring road.



tire of an upended bicycle





Three-Way Transparent Visor Is Snapped on Skiing Cap

FITTED to a new ski cap by snap buttons, an adjustable three-way visor of transparent material may be worn either close to the face or over eyeglasses. It also may be fastened out of the way, or detached entirely, when not in use. Tinted and coloriess visors, both rimless for full visibility, may be interchanged. Adequate ventilation between the eye shield and the face prevents fogging.

Double Brush Is Shoehorn, Too

A THREE-IN-ONE clothes brush recently placed on the market serves a variety of useful purposes. An auxiliary tuft of extremely stiff bristles provides a means of removing spots from suede shoes. In addition, the handle is so shaped that it may be employed as a shoehorn, as shown below.



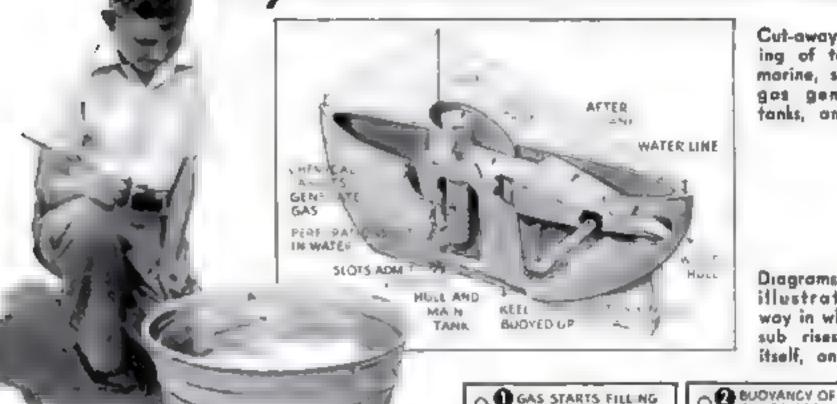
Compressed-Air Gun Delivers Concrete

THROUGH a barrel as long as two city blocks, the novel "gum" shown below shoots concrete to line water tunnels at Monrovia, Calif. When a charging box on wheels has been "loaded" with two cubic yards of a fresh mix, an air compressor

builds up 250 pounds pressure to the square inch. The gun "fires" its compressed-air charge every two minutes, driving the load of concrete mix through the length of pipe. By forcing the concrete shead intermittently, and under high pressure, the mixture is prevented from setting prematurely and clogging the delivery line.



Toy Submarine Dives and Rises

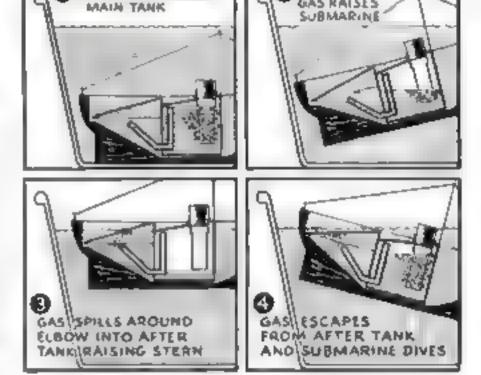


Cut-away drawing of toy submorine, showing gos generator, tanks, and tube

Diagrams below illustrate the way in which the sub rises, levels itself, and diver

The toy operates three minutes on one charge

Y CLEVERLY applying principles of chemistry and physics, a Texas inventor has developed a self-operating toy submarine. Placed in a tubful of water, it repeatedly rises to the surface and dives again, as if controlled by an unseen crew. The secret lies in a tiny gas generator, containing tablets of baking sods and tartaric acid, which react in the presence of water to produce harmless carbon dioxide gas. Buoyancy to raise the toy vessel is provided by this gas, which is shifted through a U-shaped tube between a pair of open-bottomed tanks and then released. The tanks are carefully shaped to "trim" the craft in such a way that it realistically broaches the surface bow first, levels itself on an even fore-and-aft keel, and then disappears stern last. A single charge of



chemicals operates the submarine for about three minutes, during which time it executes eight to ten dives. The gas generator may then easily be refilled with a new charge, and the performance repeated. The inventor suggests that the same principle could be used in a realistic toy whale.



Borrowing an idea from industry, department and sporting-goods stores now offer heatproof gloves of asbestos for home and camping use. Fitted with rings for hanging near a fireplace, they

save burned fingers in handling flaming logs and hot andirons, and are equally handy around camp fires and barbecues. Two sizes are available.



Toothpick
Engineering
Ingineering
Is Dentist's
Hobby

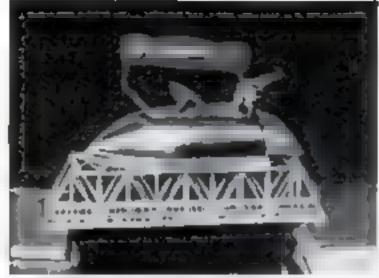
AKING scale models of giant engineering projects with flat

aking scale models of giant engineering projects with flat wooden toothpicks and household cement serving as the structural materials, is the unusual spare-time occupation of Dr. M. Russell Stein, a New York City dentist. Ably assisted by his wife. Dr. Stein transforms boxes of toothpicks into architectural masterpieces that are accurate models of their prototypes, practically perfect in every detail

Twenty-two years ago, as a boy of twelve, this toothpick engineer yearned for a construction set so that he could build bridges and towers as other youngsters were doing. But because it was not his good fortune to own even the simplest of kits, he turned to erecting structures with toothpicks and glue. The completion of his first effort, a model of the famous Eiffel Tower in Paris, France, sent him off to bed filled with pride. But the night was exces-

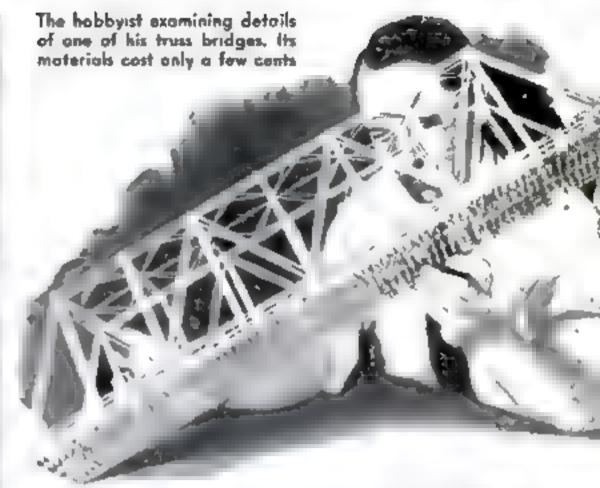
With a toothpick model, Dr. M. Russell Stein illustrates the structural design of the human jawbone. Above are two views of his model of an arch bridge. Fifty-two inches long, it contains 31,000 toothpicks

By FRANK CAPORAEL





Although it tips the scales at less than half an ounce, this ten-inch truss span can support a flatiron weighing six pounds. Some of the structures built by Dr. Stein can sustain 500 times their own weight



sively warm and morning found his model nothing but a tangled mass of sticks. The heat had melted the glue.

Undeterred by this tragedy, the lad began to experiment with various materials until he found just the right combination of flat toothpicks and household cement. Today he still uses the same simple materials, but his present intricate projects are far beyond his wildest boyhood dreams.

Take his working model of a giant Ferris wheel. This required one and a half months to build, and 27,000 toothpicks went into its construction. Each of its twenty-four cars swings on a pivot to maintain a horizontal position as the main wheel re-

volves. An accurately constructed gear arrangement drives the





Ferris wheel on a dowelrod shaft that employs a collar button as a main supporting bearing

Dr. Stein usually begins his projects by laying them out on paper. Each section is designed and then made in a single flat plane, by placing the toothpicks along the lines of the drawing and then cementing them together. To apeed the work, toothpicks are cemented together in advance, in lengths of two, three, and four. Small cutting pliers are the only tool used. When all the flat planes are complete, they are tied together with string and cemented in

place. In addition to its entertainment value, Dr. Stein says that his hobby helps him in mastering problems in dentistry, and in his work as a lecturer on anthropology

Despite their lacy, delicate appearance, the toothpick models have astounding strength. A small bridge, for instance, that tips the scales at less than half an ounce will safely support a flatiron weighing six pounds, 192 times its own weight

At the top of the page the toothpick engineer is seen at work at his drawing board, loying out his newest project

It took a month and a half to build the working model of a Ferris wheel shown at right. The cars keep a horizontal position as the wheel turns, driven by the toothpick gear seen in the photograph above.







REDGING from a small motor launch for sea life in the Gulf of Canforma recently, L. M. Paquette brought to the surface eighteen tiny apartment houses. Each consisted of a hinged ye ow shell, the top shaped like a dome the floor flat as a pancake. Sharing these strange homes, he found tiny crabs and pectens, or scattops. The shell protects both, and the crabs consume food cast off by the pectens. What the crab does to pay for its food and

The pecten apartments are only one of nany freaks of nature brought up from the sea a froot by scientists accompanying the A in Hancock Expeditions during the last nine years. More than 1,000 stations have been established by Velero III, twin-diesel cruiser presented not long ago by Capt G Al an Hancock to the University of Southern California for marine exploration. From her five small boats, scientists have investigated

By ARTHUR A. STUART

offshore islands and dredged the sea bottom many times.

Praying shrimp, fish without tails, sea cakes resembling glorified sugar cookies, sea urchins whose feet look like burned sparklers, eggs big as your hand, crabs covered by hundreds of barnacles, puffer fish and butterfly flying fish—these head the list of strange animals and plant life captured by the roying researchers.

Although no monsters have been taken, some of the finds present

weird and grotesque appearances. Perhaps the most startling, when viewed under an enlarging lens, is the mantis shrimp, captured in Mexican waters. This creature measures a scant six inches from the tip of its claws to its stubby tail. Its head looks like the sea twin of the insect praying mantis. Large enough to be eaten, the mantis shrimp carries two pairs of antenne, one projecting directly ahead between the claws, the other outward at an angle of forty-five degrees from the top of the head. How do they behave in the sea? "We have no way



Hunting sand dollars, a variety of sea urchin, in the haul from a dredge

to observe their habits," said John S. Garth, University of Southern California zoologist and supervisor of scientific work aboard Velero III. "We can only collect them infrequently, and wonder."

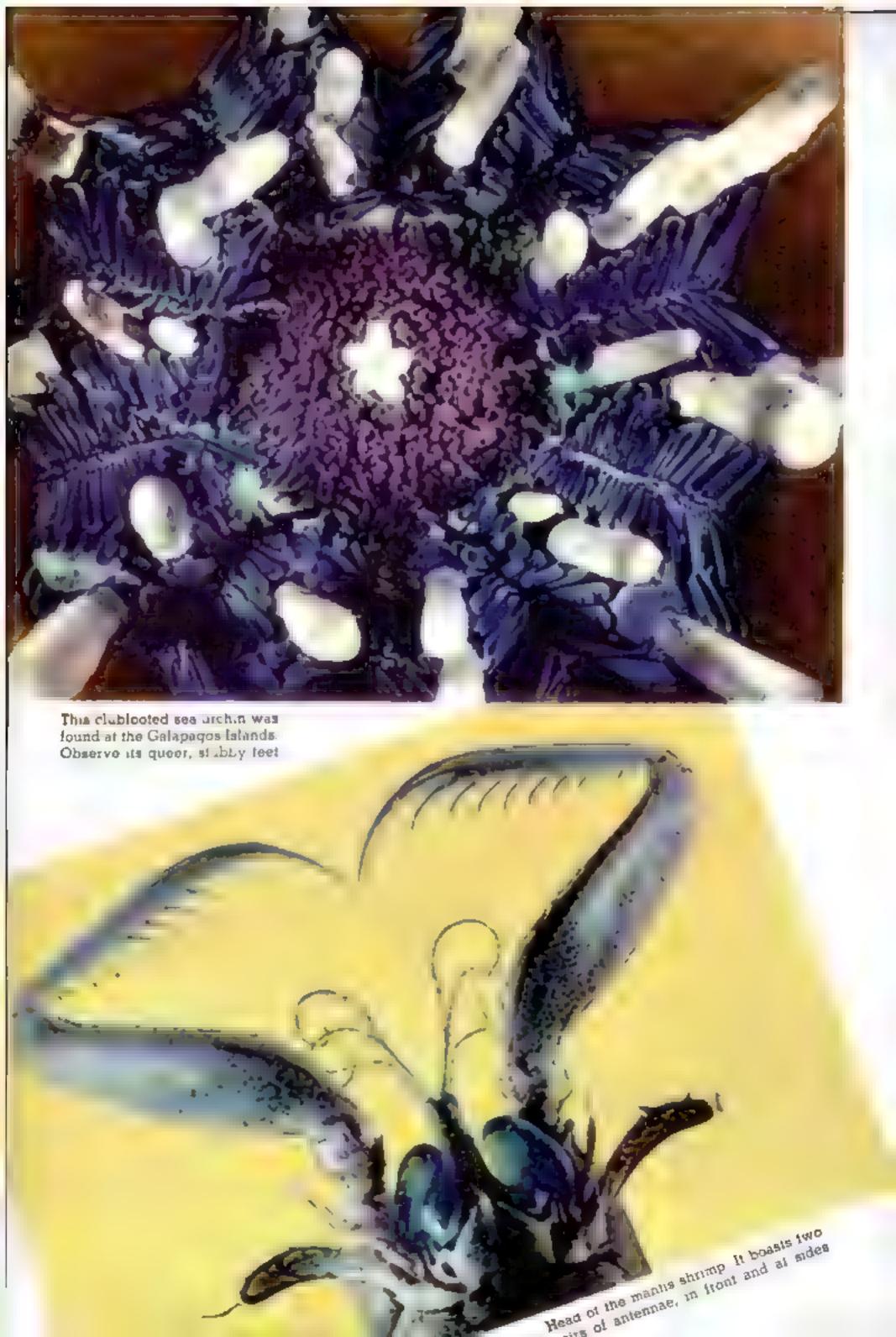
Typical dredged fish is the flounder, yet this fellow is vastly different from flounders captured near the surface. It possesses no finny tail. Caught up usually when the dredge is pulled over a sandy bottom down to about thirty fathoms, its fin is continuous from head to tail and back to head again.

Related, though different as night and



SPECIMENS ON FILM

Tiny organisms hauled from the ocean's depths are recorded by the microscope



day, the flattened sea cakes and the clubfooted "baskets that walk upside down" are both sea. urchins. The round cakes, which also are called sand dollars. look almost good enough to eat; while the latter, found near the Galapagos Islands, off the coast of Ecuador, contains a mouth and five teeth which look like a five-pointed star when closed. Its clubfeet resemble burned Fourth of July sparklers or burned cigarettes. All its outer parts seen in the picture on page 76 are scales modified by nature to perform special functions.

Captain Hancock, master of Velero III and always in command when the cruiser sails, never knows what strange creature may be added to the growing collection. From widely separated areas two unusual specimens were taken recently.

While peering through a water glass into a tidal pool on the Galapagos, preparing to photograph several underwater plants, one of the expedition cameramen saw a strange four-pronged black object float into view.

When danger threatens, the spotted putier blows himself up too big to swallow



Caught on the sea floor, this flounder has no separate tail



Barnacles growing upon the back and claws of a cancer crab





L. M. Paquette is seen opening the odd pecten shells which are shared by scallops and diminutive crabs



Quickly adjusting the lens, he obtained a rure picture of the egg case of the giant ray or skate, a vicious sea monster which weighs several tons. The case measured three by six inches, and was light enough to float

Sax han ared miles north of the Calipagos searching along the Calipagos searching along the Calipagos searching along the Calibation are as an interpretation member captured an edable cancer crabast startling in itself, for the crabast some interpretation of this force and are attached scores of barnacles. Some were tiny new-time on his hard structure for many moons. Both the crabant

In shallow waters a small dredge is diagged along the bottom by this twenty three foot whalehoat. The Iterige consists of two bags, one coarse and one fine mesh

Photographing specimens in a fidal pool. Pictures are made through a water glass, the interior of which is a minated by means of a reflector as illustrated.

barnacles are mobile, the barnacles being free swimmers. They attached themselves to the crab by their heads and kicked food into their stomachs with their feet.

Crabs cannot protect themselves against barnacles, but spotted puffers inflate themselves almost into a sphere when pelicans or pursuing fish threaten to gobble them up, thus effectively defying their enemies. Some seen over the sand of shallow bays in the Gulf of California are ten inches long. They have parrotlike beaks, yet unlike birds seem to possess real incisors.

Icthyologists know that flying fish do not really fly. They leap from the water and soar like birds in flight. Butterfly flyers often gather under the cargo light when Velero III drops anchor at the Galapagos, and will follow a moving light, sailing hundreds of feet on vibrating fins. They frequently "catch themselves" by leaping into the boats.

The acientists go deeper than the surface for rarer specimens.

In dredging in deep water, down say to a half mile below the waves, 7,000 feet of steel cable are paid out over the bow of Velero III. As the cruiser moves astern at half speed on one engine, the four-foot dredge acrapes

along the bottom. When several hundred pounds of materials are thought to have been trapped, a winch hauls the catch slowly to the surface. A half day often is required for a single round trip of the dredge. In shallower waters, as deep as a quarter mile, a smaller dredge slides downward from a platform at the stern of a whalehoat. Both these dredges are double bags, the outer coarse and the inner consisting of fine-mesh cloth through which tiny specimens cannot escape. Each has an oblong mouth made of steel.

Unusual finds, particularly fish caught at great depths which may not survive long, are placed immediately in small aquariums on deck and photographed. For these a stage is set, the aquarium being seascaped to provide natural surroundings. Thus rare specimens succumbing in the diminished surface pressure live forever in pictures.

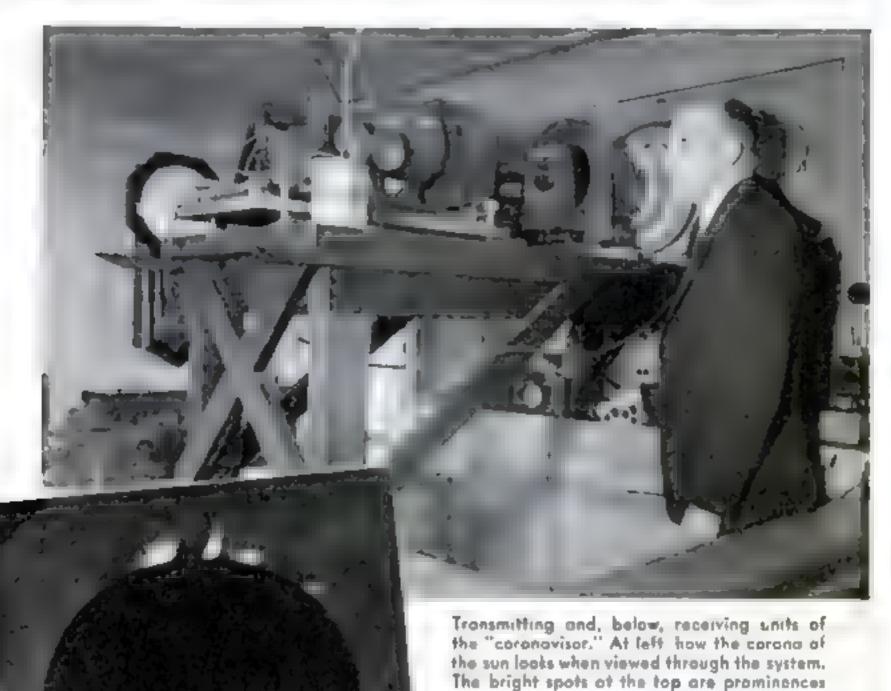
While many of the creatures captured in the ocean depths seem like freaks when compared with more familiar varieties, they are as natural in their own habitat as their relatives living in shallower waters. By dropping their dredges onto the ocean floor, the scientist-explorers aboard Velero III are penetrating a new and uncharted realm of marine life.

Dredging winches and other gear on the forward deck of the "Velero III" during operations.





Television Camera Shows Sun's Corona



O LONGER need astronomers wait for a total cohpse to view the sun's corona, or halo of glowing streamers, which usually is masked by the thousandfold brighter light of the sky. In a "coronavisor" perfected by the Bell Telephone Laboratories, a television camera spirally scans the area around the sun's disk, and electrical filters discard all reception produced by the sky's uniform light. Thus the "unmasked" corona, and brilliant prominences at the sun's rim, are clearly seen against a black background on the viewing screen. The new aid may help forecast solar disturbances that trouble shortwaye radio transmission.



Crane Car Speeds Up Track Laying

A GIANT track-laying machine designed by T. Platov, a Soviet engineer, is now being used in the construction of new railway lines in Russia. Rolling on sections of track already laid, the device is coupled to flat cars on which are piled standard-length sections of rall already spiked to ties. A crane

picks up one section of track, swings it out in front of the machine, and lowers it into place on the previously prepared roadbed. Workmen then fasten it in place, and the track-laying car advances over it into position for laying another complete track section, as shown above.

Secrets of Static Electricity Revealed in Car Tests

STATIC electricity in charges as high as 11,000 volts is often generated in automobiles that speed over concrete or asphalt roads. This is one of the interesting facts established by Prof. Robin Beach, of the Polytechnic Institute of Brooklyn, N. Y., who is conducting a comprehensive study to determine how static electricity is generated and released by cars,



Prof. R. Beach applies a test prod to the fender of a car running on reliers

At right, measuring with instruments the amount of static discharged by car





Amply padded against injury, this fireman landed in a thicket. His parachute disposed of, he'll be ready to fight a forest fire

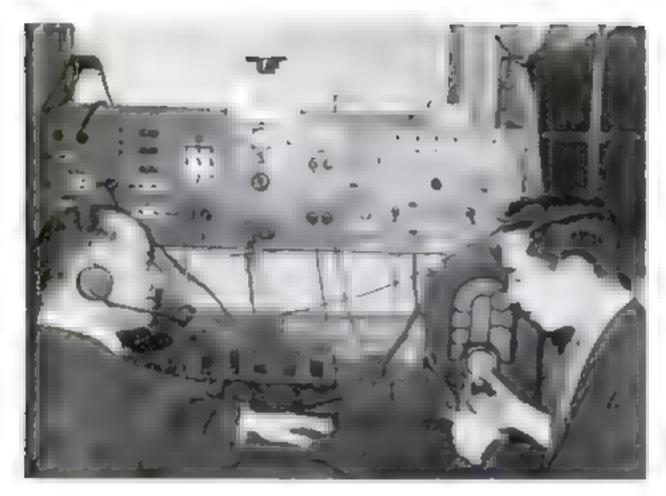
Flying Fire Fighters Parachute to Work

PLUNGING earthward by parachute, Government flame fighters may soon reach otherwise inaccessible sections of a forest to snuff out beginning fires. This spectacular method of coping with a menace which brings an annual loss of more than \$100,000,000 to Americans, was recently demonstrated successfully in forest areas near Wenatchee, Wash.

Clad in a special suit of canvas and sponge rubber, and protected by a face mask of metal mesh, Frank Derry, West Planes and parachutes will rush farest - fire fighters up to the scene of action

Coast parachute jumper who cooperated with officials of the U.S. Forestry Service, stepped off the wing of a circling plane and dropped unharmed into the thick forest growth 2 000 feet below. Smoke eaters of the Forestry Service, carrying compact fire-fighting equipment on their backs, could thus reach the scene of a remote forest fire almost as soon as smoke was sighted.

Subduing flames in this manner, before they could spread, would save millions of dollars a year. During the twelve months of 1938, Blone, fire destroyed nearly 34,000,000 acres of timberland, an area virtually equivalent to the whole of New England. The annual average number of forest fires in the United States is around 175,000, of which about 15,000 are started by lightning. A new blaze begins on the average of once every three minutes.



College Sophomore Wires His Campus for Sound

FOLLOWING in his father's footsteps, Edward Sarnoff, son of David Sarnoff, president of the Radio Corporation of America, is managing an unusual broadcasting network. The system, installed at Brown University, Providence, R. I., where young Sarnoff is a sophomore, is similar to the wired-radio systems established in many major cities. Programs originating in the college studio are sent out over wires to the various campus buildings, where students listen to musical programs, news, and announcements concerning college affairs. In the photograph above, David Sarnoff listens in as his son speaks into the mike.

Saddle for Knee Holds Complete Manicure Set

DRAPED over the knee like a miniature saddle, a manicuring aid recently introduced consists of a broad strip of soft woolen cloth fitted with convenient pockets that hold nail polish, cuticle remover, emery boards, orange sticks, and other manicuring accessories



Everything needed for a manicure is held in the pockets

Kit for Carving Plastics Has Small Power Tool A hand-size power tool has a complete set of accessories for shaping, cutting, and sanding vorious plastics

COMPLETE tools and materials for carving plastics are now available in kit form. Made small and large styles, the kits include an electric hand-size power grinder and a complete set of quicklyattached cutting, polishing, and sanding wheels. A supply of plastic ma-

terials in tube, sheet, and rod form; pins, acrews, glass, and an enameling brush; and a complete project book with suggestions on what to carve and how to carve it, are also part of the outfit.



Numbers Mark Soldiers in Training

NUMBERED like football players, members of a British gun crew learn how to play the grim game of war. During a practice exercise, the numerals on their backs ald the instructor to coach each individual in his duties, so that perfect teamwork will result. The picture above shows gunners training "somewhere in England."



Spraying a tree with a winter protective chemical

Spray Replaces Burlap for Protecting Trees

For protecting valued trees against the rigors of winter, a new chemical treatment takes the place of burlap wrappings. The picture at left shows the protective compound being applied with a spray gun to a dogwood tree.

Handle Opens New Knife

By ROTATING its cover through a complete circle, the springless blade of a new "safetyfirst" pocket knife is locked open or shut. It cannot snap back on a finger, and need not even be touched to open or close it.



This knife can be opened without touching the blade



Daring Diver Feeds Diving Dolphins

AN UNDERWATER picnic at which a diver hand-feeds a school of porpoises while at the bottom of an outdoor tank, is a novel stunt performed daily at an aquarium in Marineland, Fla. Dressed in full underwater regalia, the diver enters the tank carrying a wire basket full of small fish. Descending

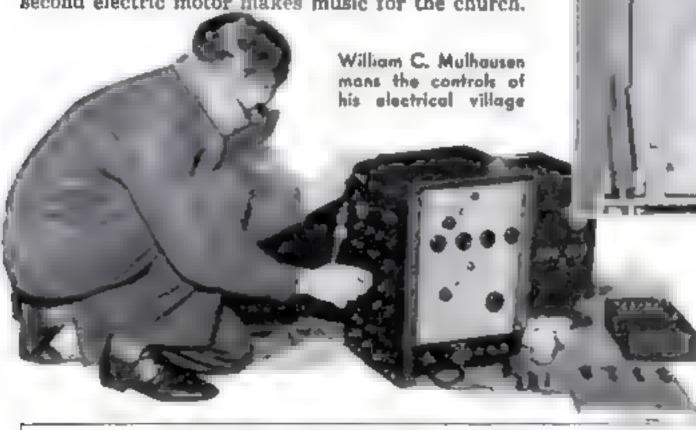
to the bottom, he sits on the tank floor twelve feet below the surface and feeds the aquarium's dolphins by hand. The unusual photograph above was snapped through a window in the side of the tank as one of the graceful creatures paused only long enough to snatch up a mouthful.

Christmas-Tree Village Comes to Life

TWENTY-ONE rheostats. thirty-three switches, and six telegraph keys, mounted on half a dozen switch panels in between an array of voltmeters and ammeters, control an amazing Christmaa-tree diaplay developed by William C. Mulhausen, of Brooklyn, N. Y., over a period of fifteen years. In front of the tree, which is decorated with 196 red. white, blue, and green rheostat-controlled bulbs, is a miniature village complete with trees, houses, a church. lighthouse, windmill, and other buildings. Back of this is a panorama, depicting a forest acene, painted on glass and back-lighted.



A miniature farm borders the tiny village on the right, and a harbor scene, with ships riding on a glass mirror that simulates water, is placed at the left. Buildings and boats are lighted from within, and various noise makers in a box mounted on a motor-driven shaft produce the brays and bleats of the farm animals. A toy hand organ driven by a second electric motor makes music for the church.

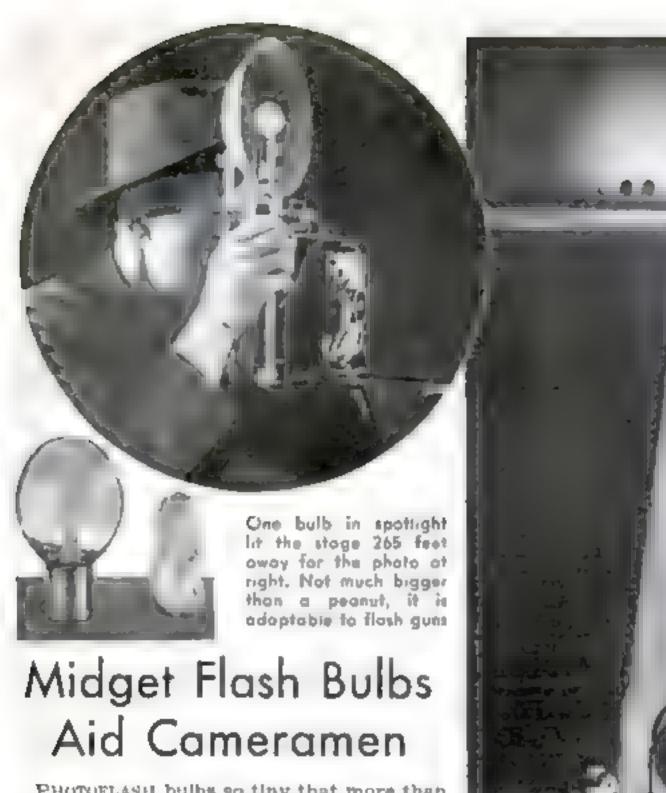


Set at the base of the Christmas tree, the layout represents a peaceful yuletide scene. Lawer picture, some of the off-stage sound effects

Write a Letter and Win a Prize!

HERE'S your chance to earn some money to buy new tools or equipment for your hobby! POPULAR SCIENCE MONTHLY is affering \$100 in prizes for the best letters from readers, telling what they like best in this issue, and why. Turn to "Our Readers Say" for details, and get your letter off at once. It may be a winner!

FEBRUARY, 1940



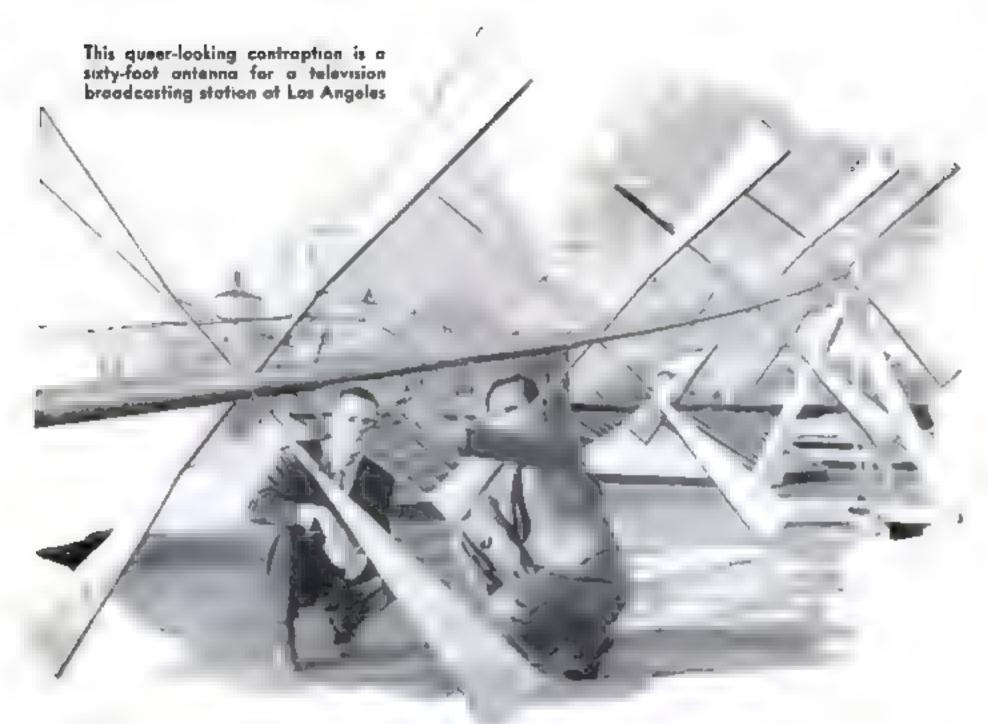
Photoflasii bulbs so tiny that more than two dozen can be carried in a coat pocket have just been introduced. With glass globes smaller than a golf ball, their improved efficiency is said to give them more light for their size than any existing type. Made with bayonet-type bases like those of auto lamps, the wire-filled midgets are for use in hand reflectors, or in spot projectors as shown in the photograph at the right.



This roller-skuting attendant wastes no time walking

Gas-Station Attendants Wear Roller Skates

ATTENDANTS wearing roller skates make quick work of filling a motorist's needs, at an Oklahoma service station. Practiced in performing all their duties on wheels, they fill a customer's gas tank, check his water and oil, clean his windshield and windows, and send him on his way with a minimum of delay. According to the proprietor who put the idea into use, patrons have expressed their hearty approval of the innovation—after getting over their astonishment on seeing the attendants approach their cars in this unusual fashion.



"Paddle Wheels" Form Television Aerial

No MATTER what you guessed to be the purpose of the windmill-shaped thing above, you'd probably be wrong. Actually, it's the newest fashion in television transmitting

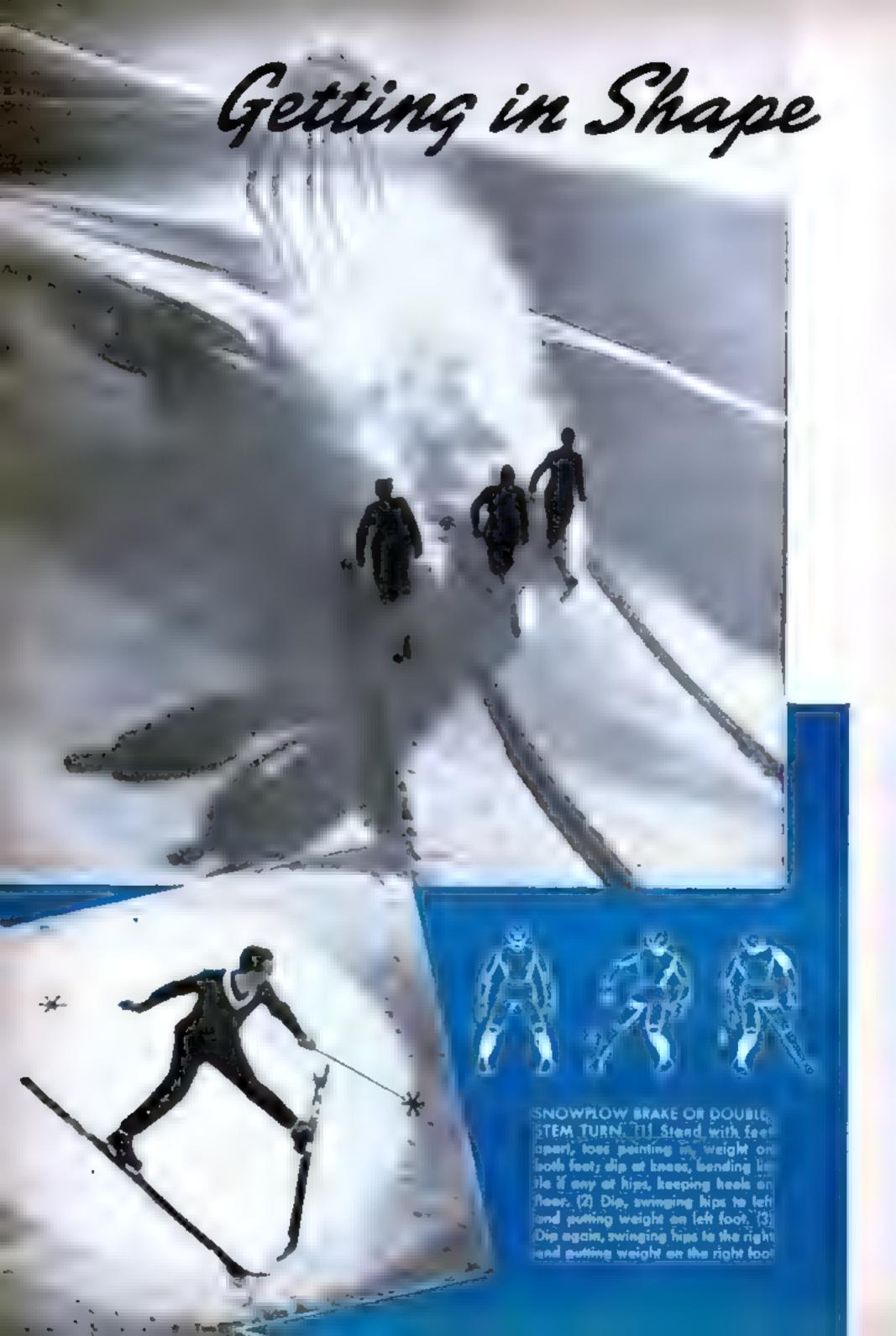
antennas. Just completed for a broadcasting station at Los Angeles, Calif., the big aerial measures sixty feet long and will be mounted vertically.

How To Gather Fleas from a Grizzly Bear

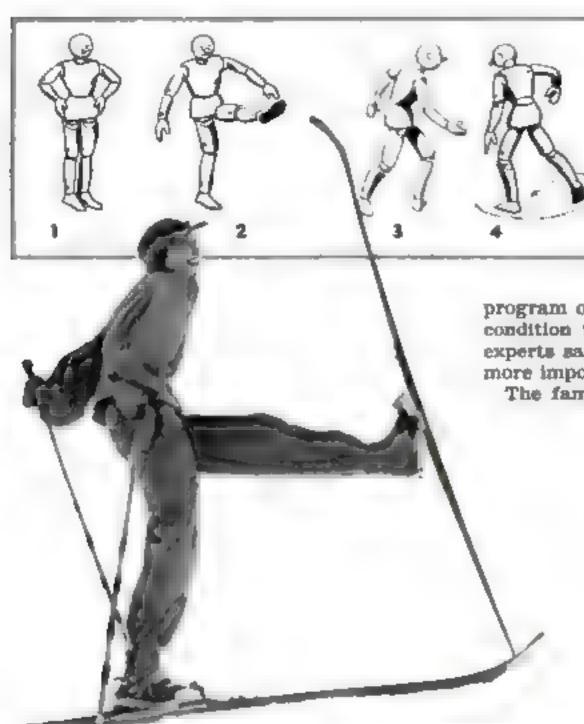
How to get fleas from a grizzly bear might puzzle a less resourceful man than Walt Sutter of Tacoma, Wash. From a radio program he learned that a wealthy Englishwoman was in the market for grizzly-bear fleas, to complete a collection taken from various wild animals. So he went to a zoe with a long-nozzled vacuum cleaner, and soon the coveted specimens were in the bag, ready for a purchaser.



Walt Sutter harvesting grizzly-bear fleas to sell to a flea collector





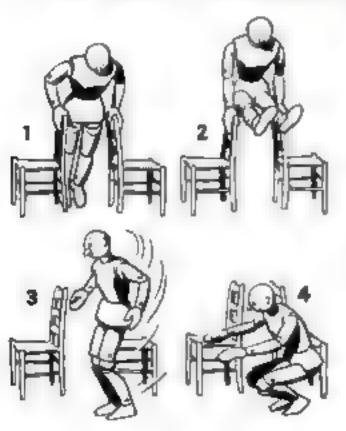


KICK TURN. For this standing turn, take position (1) with feet parallel. (2) Lift left leg and twist foot to left when it is hip-high. (3) Screw left foot around so that when it touches the floor it is pointing in opposite direction to right foot. (4) Put weight on left foot and swing right foot alongside it

program of exercises that limber, tone, and condition their muscles. For the beginner, experts say, preliminary exercises are even more important.

The familiar "daily dozen" that includes knee-flexing, hip-twisting, and deep draughts of fresh morning air. Is a good routine to start with. But for more ambitious skiers, special exercises have been devised to get muscles into top-notch shape for performing the turns, brakes, and other skiing maneuvers. Six of these exercises are outlined on these Faithfully performed, they should help any enthusiast get into first-class shape for an acheless season of good skiing.

JUMP TURN BETWEEN POLES. Sat two straight-backed chairs as shown, 18 inches aport. (1) Lean forward with body weight supported by arms, hands grasping middles of chair backs. (2) Swing legs forward parallel to floor. (3) Twist the feet to right and land with legs stiff, feet at right angles to first position (4) Dip with knees bent to absorb shock

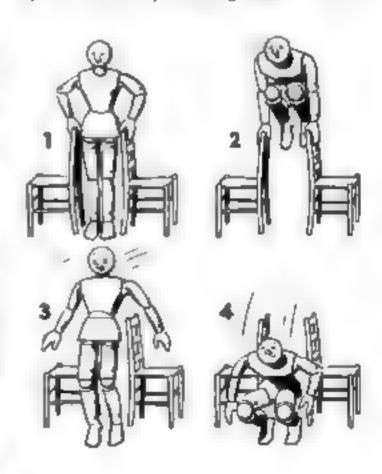








GELANDESPRUNG. This flying leap is practiced with chairs placed as for the jump turn between poles. Stand between the chairs (1), grasping the backs with the hands. (2) Lift the body, drawing the knees up near the chest, head and chest forward, hips high. (3) Return to floor with knees bent only slightly. (4) Take up the shock by bending into a crouch



Learn to ski by the sea: The enthusiasts at the left are receiving instruction on the sands of the shore



Pickaback Model Cuts Aerial Capers

AN OUTSTANDING feature of a model-airplane meet held recently in Philadelphia, Pa., was a diminutive "pickaback" combination plane inspired by the full-aize composite aircraft tested for Transatiantic service in England (P.S.M., Jan. '38, p. 30). Entered in a special stunt contest, the single-engine model monoplane took off with a small glider mounted on its back in a special cradle. After gaining sufficient altitude, the plane automatically released the glider, which soared away, released two tiny parachutes, and then unfurled a third chute by which the glider itself floated down



This playroom electric phonograph will play twelve-inch records

Tiny Phonograph Has Cone Speaker Set in Tone Arm

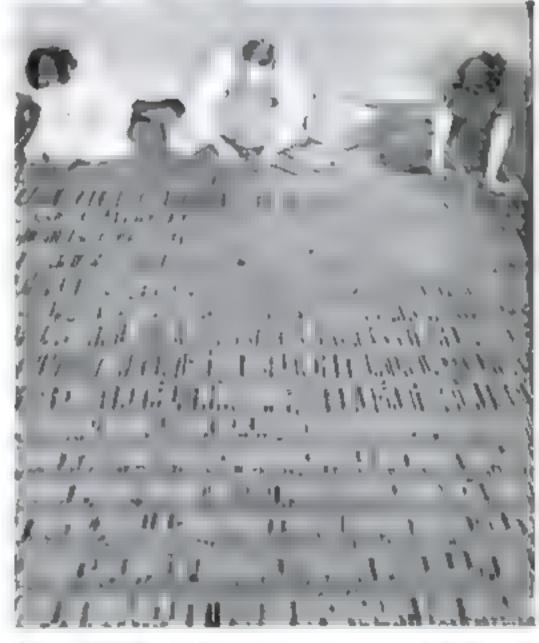
DESIGNED for children's use in a nursery or playroom, a diminutive phonograph now on the market is operated by an electric motor and employs a novel sound box. This consists of a diaphragm resembling a loudspeaker cone and housed in the phonograph tone arm, whose unusual shape can be seen in the photograph at the left, Not a mere toy, the machine will play records up to the twelve-inch size.



A TRAIN crash was arranged recently to celebrate the completion of 8,000,000 miles of travel by the Denver Zephyr, a streamline train of the Burlington Route. Little damage was done, however, for the obstacle which the streamliner hit was a mammoth paper hoop. The celebration took place at the proper point on the main line of the railroad near Belmont, Ill., when the Diesel-powered train poked its nose through the paper hoop.

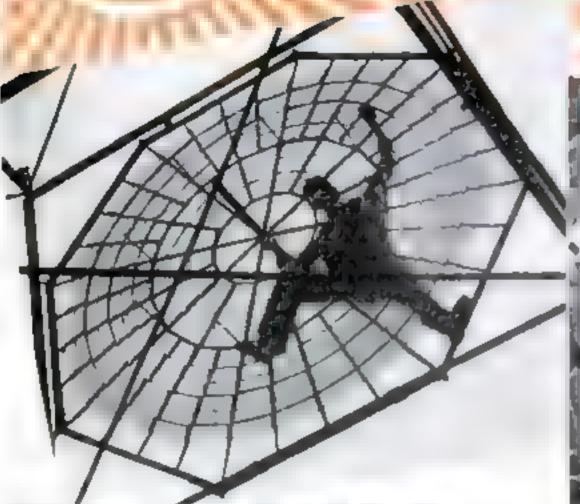
He's Never Caught Without a Pencil

Collecting pencils of all sizes, styles, and shapes is the odd hobby that occupies the spare time of B. D. Sumpter, of Topeka, Kans. Now numbering more than 7,000 individual items, coming from all parts of the world, the unusual collection includes more than 2,500 different mechanical pencils. In the photograph at the right, Sumpter, his wife, and a friend are shown arranging the items in the collection on the floor of the living room.



Some of the 7,000-odd pencils accumulated by B. D. Sumpter

ROOF-TOP STORES POWER





In one effort to harness sunlight, a Spanish inventor melted metals with solar heat gothered by prisms set in a spider-web frame



A TRAP FOR OLD SOL. Here a workman is polishing up the prisms of the solar furnace shown above. The tower turns to face the sun

EATING homes in January with the warmth of last summer's sunshine that is the exciting goal of research now under way at Cambridge, Mass, Not far from the Charles River, scientists of the Massachusetts Institute of Technology recently completed a white frame building, its sloping roof edged with a glistening battery of solar-heat traps,

These cells are formed of "sandwiches" of glass sheets, air spaces, and metal plates. The rays of the sun penetrate through the sheets of glass and strike a black metal plate at the bottom of each cell. It absorbs heat rapidly and the dead-air spaces between the glass panes act as insulators and keep the heat from dissipating outward. Beneath each metal plate, a maze of thin-walled tubes carries a flowing stream of water which is heated by contact with the metal and then conducted to an efficiently insulated storage tank in the basement of the building. Hot water can be stored in such tanks, it has been found, for weeks and eventually it is expected that "sunshine

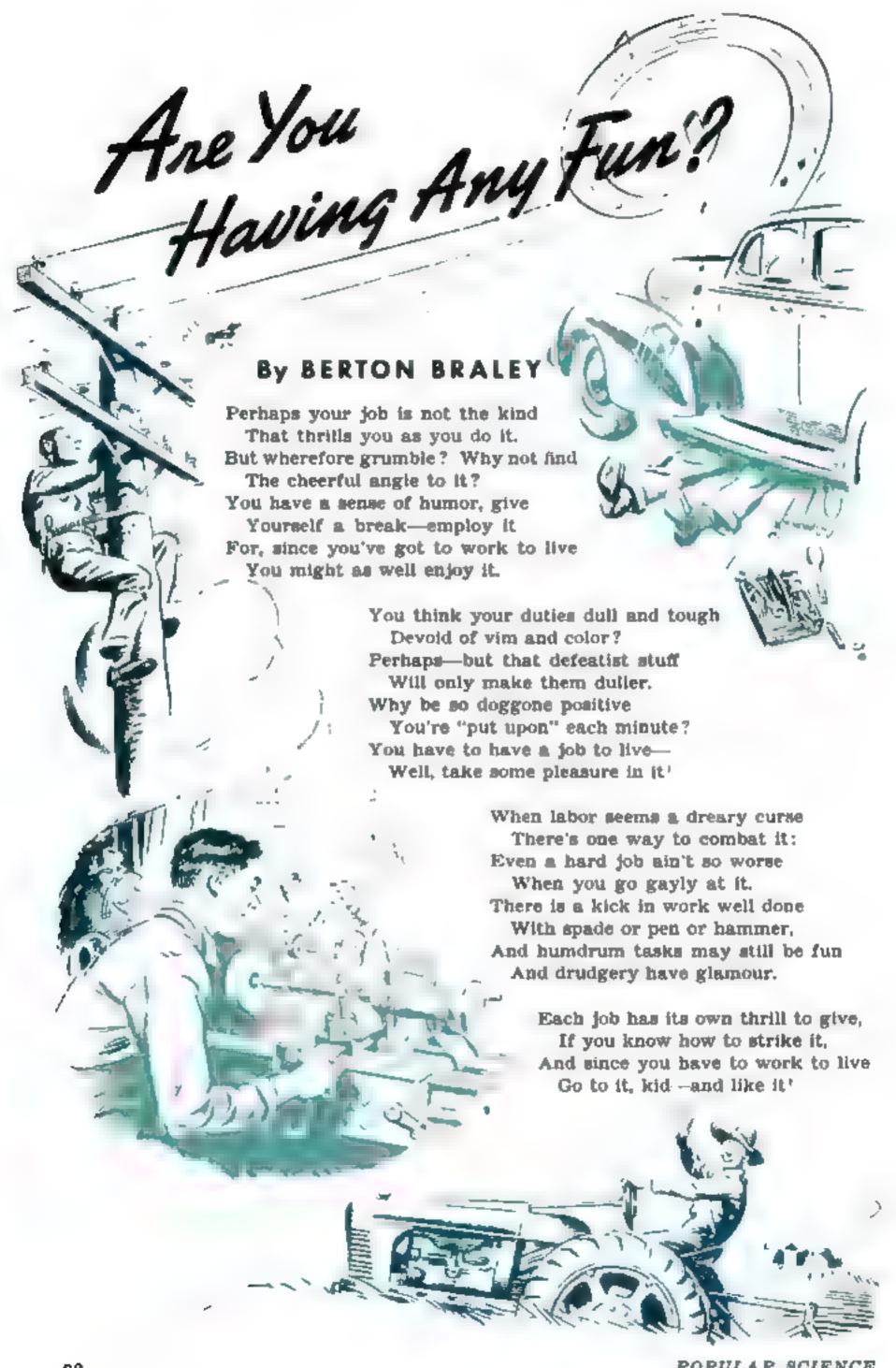


SUN HEATS HOT DOGS. Two Colifornians intehed a dag wagen to a star in this ingenious solar barbecue. A thermostatic control adjusts mirrors to reflect the sun's heat for cooking meats

Dr. C. C. Abbot's solar furnace to the "sunshine sandwiches" of Dr. Bruno Lange, of Berlin, Germany. His photo-electric cells generate current when struck by the sun struck by the sun struck by clockwork, and

giant lenses, concentrat-

ing heat to melt metals.

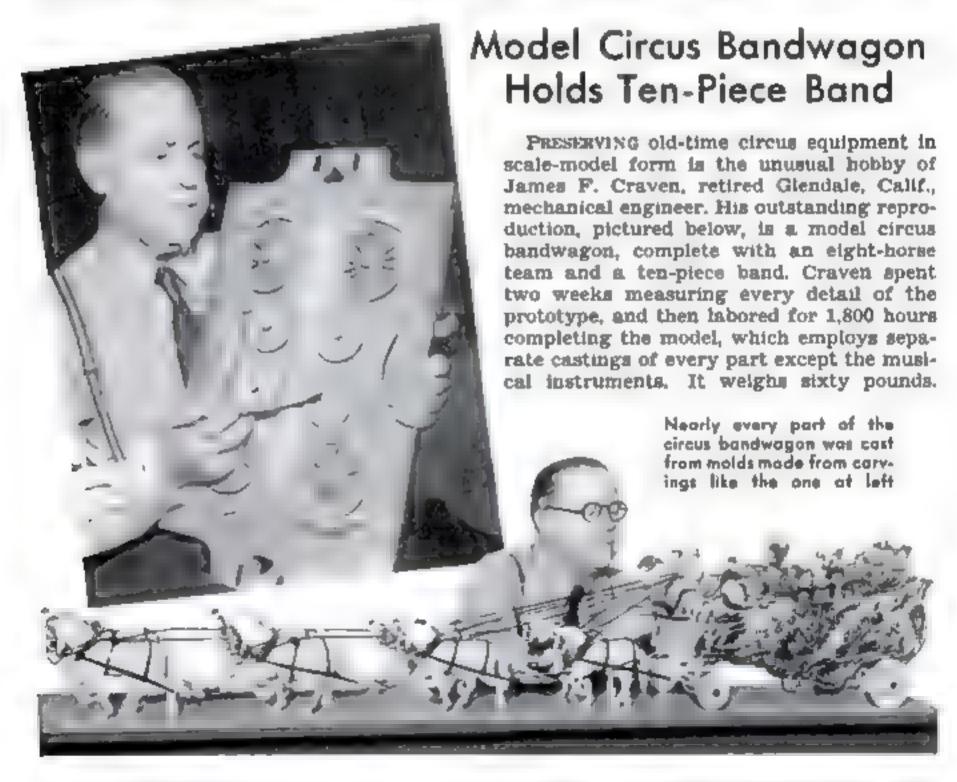


Light Motor Goes on Bike in a Jiffy

WRENCH and acrew driver are the only tools required to install a novel bicycle gasoline motor that drives a wheel 120 miles on a galion of gas at speeds up to thirty miles an hour. Normal pedaling is not interfered with, since no structural changes are required. The motor fastens below the bicycle cross bar, driving the rear wheel by means of a apecial contact roller against the tire. The twenty-five-pound, four-cycle motor is rated at one and threeeighths horsepower.



The man is pointing to the special roller drive that contacts the tire

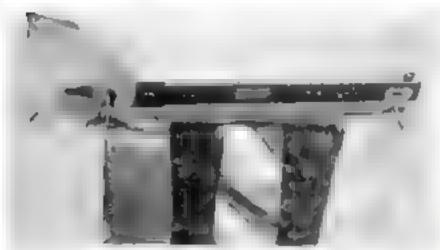


TED & MONE HOMEY MING. IN SAN DR.GO

This sidewalk printing shop puts any headline you wish on a local paper

Headlines Are Made to Order While You Wait

PRINTING special headlines to order on copies of a newspaper is the unusual aidewalk enterprise recently inaugurated in Hollywood by two Californians. Attracted by the novelty of the idea, passers-by pay twenty-five cents to have their names inin bold-type headlines of their own composing, which are set up and then run off on the portable curbside press.



Held between rods, neckties can't fall to the floor

Spillproof Necktie Rack

NECKTIES will not slip nor slide off a novel hanger just placed on the market. Thes are draped over a metal rod held out from the hanger's wooden back by two side arms. A second metal rod, which likewise may be used for neckties, snaps forward to hold the ties in place and prevent them from slipping off. This is pushed back out of the way when selecting a tie from the hanger.

Bergen and McCarthy Build a New Ant Trap

WHEN a horde of invading anta threatened to take over the Beverly Hills, Calif., home of Edgar Bergen, the well-known radio and screen ventriloquist retired to his home workshop and built a novel ant trap. The invention consists of a rectangular wooden base, beveled on the sides, and fitted with metal plates on the top and side edges. The plates, slightly separated from each other, are connected through a transformer to the house electric current, and a bit of honey is smoothed on the top to lure the insects. An ant chimbing up the sloping side of the trap spans the gap between the plates, and causes a short circuit that electrocutes it.

\$100 IN PRIZES for letters telling what you liked best in this issue, and why. For details see "Our Readers Say."



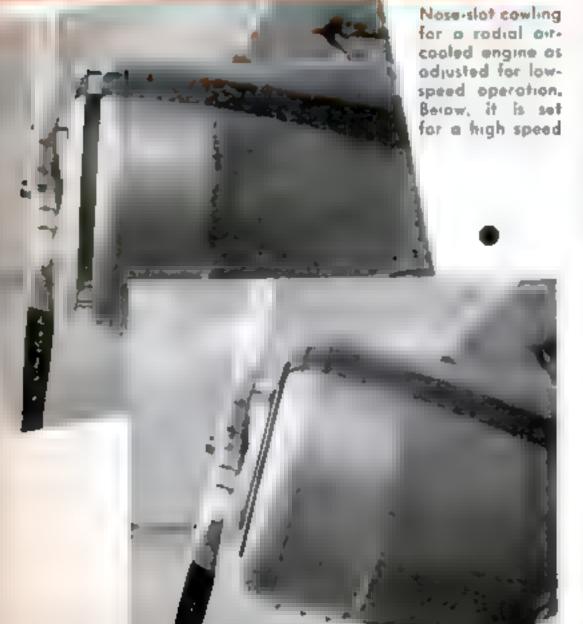
Edgar Bergen dusts dead ants away from his ant trop







Planes of the future will have volvet-smooth wings like this. The arrow indicates apparatus for measuring "drag



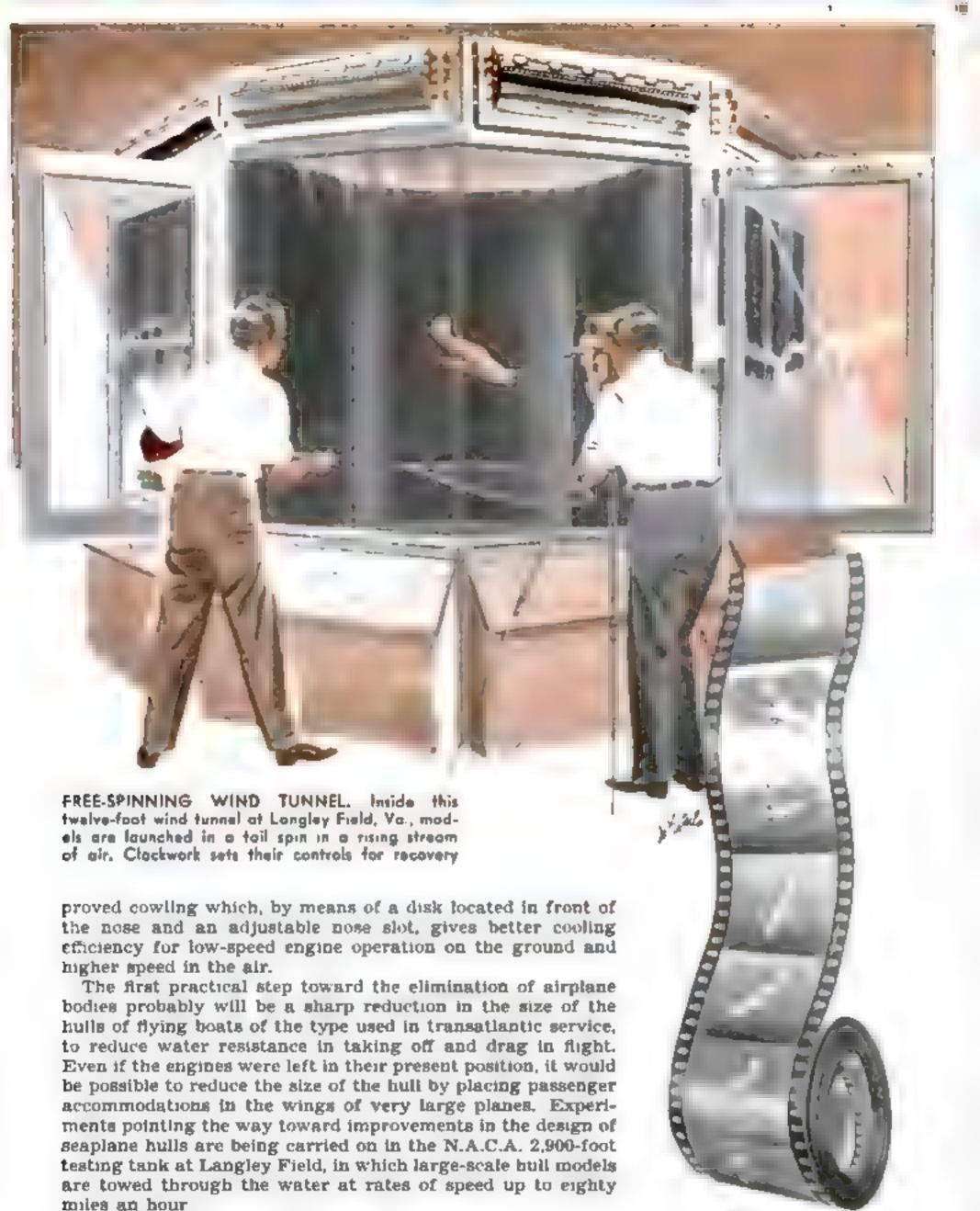
today because it means increased flight speeds without increased power and with decreased operating costs.

Wind-tunnel investigations at Langley Field, a few years ago, resulted in an increase of fifty miles an hour in the speed of multi-engined airplanes by showing designers that the best position for engine nacelles is directly in line with the wings—a discovery which is considered the most important single contribution to the increase of airplane efficiency since flying began.

Dut even with the nacelles in this most effective position, in a four-engine plane they increase drag by about eight percent. Recent investigations, now being continued at Langley Field, showed that this drag can be practically eliminated by mounting the power plant in the wings and connecting the engines with either tractor or pusher propellers by means of extension shafts. Successful experiments have been made with a "flat" engine designed for in-wing use.

It has been found that engine-cooling apparatus increases the drag by over fifteen percent, and that this drag is greatly lessened by placing the engines in the wings and cooling them with air led through ducts in the wing surface. This method reduces the proportion of the engine's power needed to cool itself from ten to fifteen percent to two or three percent, resulting in increased speed.

Some years ago tests in the twentyfoot wind tunnel at Langley Field led
to the development of the N.A.C.A.
cowling for radial air-cooled engines
which by lowering drag and reducing
the power required to overcome the
air resistance of the engine increased
speed and saved airplane operators
millions. Continued experiment has
resulted in the development of an im-



In proportion to its greatly increased size, the airplane of the foreseeable future will have a wing surface considerably smaller than has the plane of today. As a result of constant improvement, airplane wings now carry twice as much weight to the square foot of surface as they did a dozen years ago, and this heavier loading results in smoother flying.

Ingenious advances in wing design also are resulting in

MOVIES SHOW MODELS IN ACTUAL FLIGHT

Motion pictures of the model in the wind tunnel show it coming out of the spin, and indicate whether such a plane would be controllable increased speed without increased power. It is reported unofficially that a new type of wing developed at Langley Field, its design carefully guarded as a military secret, has resulted in the building of a new Army plane with a top speed of 500 miles an hour—which is a lot faster than any other nation's fastest war plane. And speed is of utmost importance to fighting planes.

As airplane speeds progress toward what

most flight scientists regard as the ultimate of about 600 miles an hour, devices which make possible both safe take-off and landing speeds and extreme speed in the air become increasingly important. Wind-tunnel tests at the Langley Field laboratories a few years ago resulted in the development of the Fowler variable-area wing, which has an extensible surface of the same sectional form as the wing, with a gap between the main

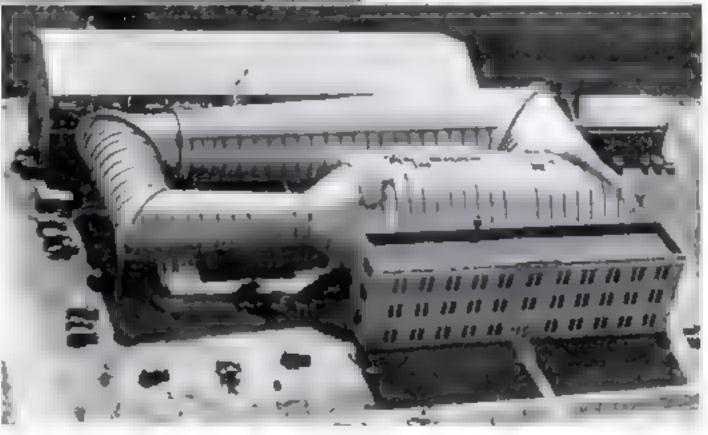
wing and the extension which helps to maintain a smooth flow of air over the wing surface. This flap is extended to increase lift in taking off and landing, and retracted to reduce drag while flying at high speed. Such finps now are used on all high-performance planes Until recently the Fowler wing gave the highest lift of any of these devices—thirty pounds to the square foot at sixty miles an hour, about double the lift of an ordinary wing. Now tests have shown that a multiple flap of the so-called Venetian-blind type gives a higher lift and lower drag than even the Fowler wing. Experiments with multiple flaps are being continued with highly encouraging results.

Modern design and streamlining of the fuselage and other parts have reduced form drag so much that in the planes of today skin friction often is the cause of more than half of the total drag. N.A.C.A. investigations indicate that it is the little things that will count most (Continued on page 244)



In this sixty-foot sphere a pressure of two or more at maspheres can be maintained to test models for stability and handling

One of the latest o ds to aeronautical research in the United States is the rineteen-fact wind turnel at the right, also located at Langley Field





Novel Service Breaks In New Shoes

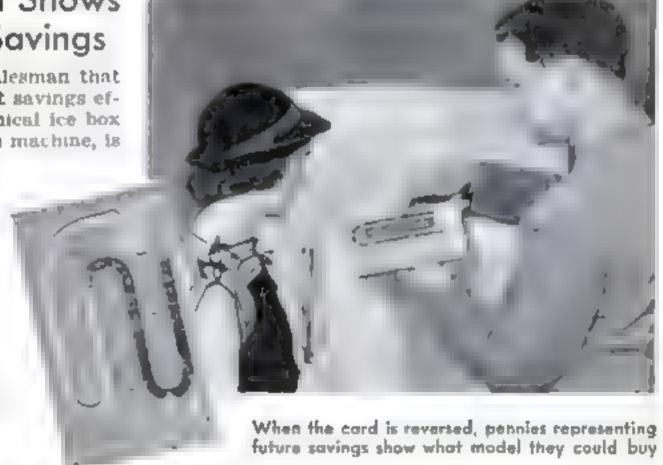
BREAKING in stiff new shoes for persons with tender feet or for women who want to squeeze a size-eight foot into a size-six shoe, is one of the unique services performed by the operators of a New York City firm. A corps of girls takes on this unenviable task,

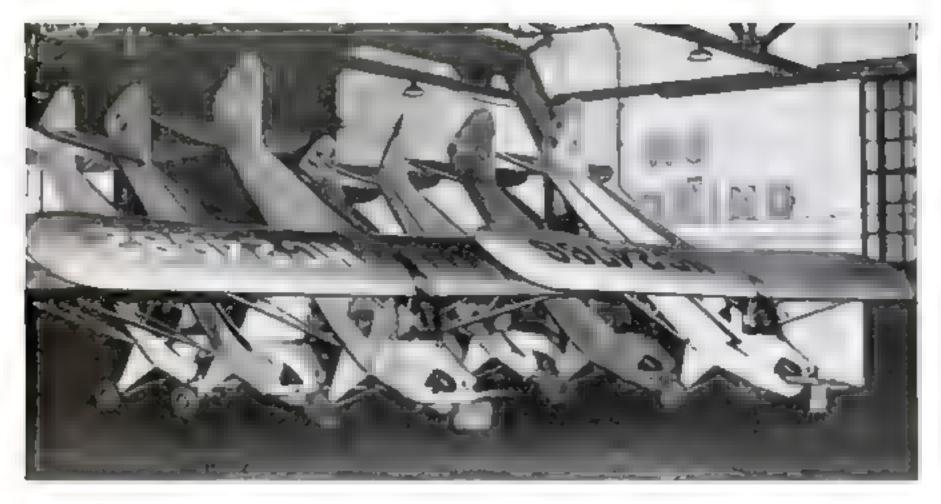
while the proprietors busy themselves with other unusual requests of clients, such as filling a midnight call for a violinist to play a sick child to sleep, and first scouting around for and then purchasing two penguins as a present for a pet lover.

Salesman's Aid Shows Refrigerator Savings

A ROBOT cardboard salesman that proves to customers that savings effected by a new mechanical ice box will actually pay for the machine, is

now being used in refrigerator salesrooms.
Placed in a slot in the
card, pennies represent
daily savings in operating cost, reduced food
spoilage, and quantity
buying, gained by substituting a new for an
antiquated refrigerator.
With the card reversed,
the pennies indicate
what refrigerator model
the savings can buy.





Planes Parked on Noses Save Space

FIFTEEN planes can be parked in the space ordinarily filled by five or six, by the use of the novel stacking method pictured above, employed in a hangar at the municipal airport at East Boston, Mass. Plane wheels are blocked and each craft is balanced on its nose with a wooden support protecting the propeller.



Realistic Moving Targets Train Antitank Gunners

CONSTRUCTED of wood and cloth, and equipped with wheels and ground skids, dummy tanks are drawn across open terrain at a speed of twenty miles an hour to give practice to British antitank-gun crews. Pierced by numerous direct hits, a dummy tank is pictured at the left after practice.



Towed across a field, the dummy tank (inset) offers a practical target for antitank-gun training

Airplane Is Cosmic-Ray Laboratory

PROBING the mysteries of cosmic rays. strange and powerful radiations that bombard the earth from outer space, acientists have descended to subterranean tunnels and climbed to mountaintop laboratories in their efforts to ferret out the hidden secrets of the rays. Recently a new locale was tried when three experts installed delicate cosmic-ray-detecting apparatus in a plane for a high-altitude flight. Wearing oxygen masks, the experimenters put their apparatus into operation at an altitude of 29,000 feet. Dr. Arthur H. Compton, coamic-ray authority, sided them by radio from the ground.



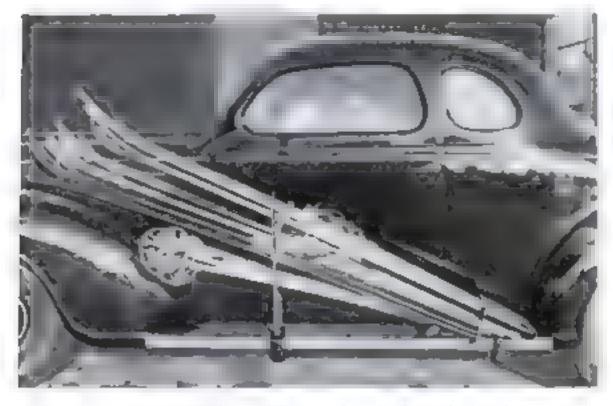
Breathing oxygen, three scientists study cosmic rays nearly six miles up



Ready-shaped parts make the models easy to build

Model-Train Kits Trace Railroading's History

ALL the materials required to construct wooden models of old-time rail-road locomotives are now available in kit form. In addition to wheels, stack, boiler, and other shaped parts, the kit includes supplies of sandpaper and glue. The model pictured at the left is the J. W. Bowker locomotive which was built in 1875 and played an active part in the Nevada mining boom of that time. Kits for modern as well as historic engines are available.



Six pairs of skis and their pales are handled easily by the carrier

Ski Rack Fits on Car Running Board

Six pairs of akis and aki poles can easily be carried on the running board of an automobile with an inexpensive carrier now available. Skis are placed at an angle with their heels on the running board near the rear fender and their tips facing forward over the front fender. They are held in place by vertical metal arms that are fastened to the running board by hand-screw clamps.

Merry-Go-Round

ELIEVED to be the only one of its kind in the world, a novel "merry-go-round" observatory has been designed and built by Leslie C. Peltier, of Delphos, Ohio. One of America's foremost amateur astronomers, this thirty-nine-year-old observer has been showered with scientific honors for his discovery of a new star and seven new comets-including the great Peltier comet, brightest since Halley's Comet In 1910-and his 50,000 observations of variable stars. Now he makes another major contribution to astronomy in the design of the new back-yard observatory from which he scans the night sky

astronomer." As well as it suits his six-inch refracting telescope, he declares it could be still better adapted to any of the thousands of homemade reflecting-type instruments in use throughout the country.

When Peltier wants to shift the direction





ACE AMATEUR STARGAZER
STALKS COMETS WITH A
NOVEL TELESCOPE MOUNT
HE BUILT FOR HIMSELF



Exterior of the midget observatory, and the base framework with circular track. Wheels are from a child's merry-go-round

of his telescope, he turns a steering wheel, and the whole observatory revolves. A small control wheel in his other hand raises or lowers the instrument. Thus, sitting in a comfortable uphoistered chair, he can quickly sight upon any object in the heavens. As the telescope moves from the horizon to the zenith, its eyepiece describes an arc that he can follow merely by tilting his head, thanks to clever placing of the bearings on which the counterweighted framework pivots.

In a conventional astronomical observatory, the observer sees only a narrow strip of the sky, but in Peltier's design he sits so Peltier shows how the lid is lifted from the telescope well. The inside of the structure is pointed a dead black to minimize light reflection

close to the opening that fully a tenth of the starry scene is visible—a great advantage to students of meteors, or to those who like to see a whole constellation to find their way about in the sky. At the right hand of the observer stands a convenient desk, illuminated by a ruby lamp. To minimize reflections, the whole interior is painted dead black.

Midget in size, Peltier's homemade observatory measures only six feet square and five feet high. By exercising his ingenuity, the

designer found his materials easy to obtain. The four roller-bearing wheels and the circular track on which the building rotates are stock parts for a children's merry-goround. A pair of water-pump pulleys, one bolted to a wheel and the other mounted on a pipe welded to the steering wheel, provide a V-belt drive. A central bearing admits an electric cord for the lamp and, in severe weather, for an electric heater. Structural items include a base framework of two-by-fours bolted together, a floor of plywood, siding of pressed-wood composition board, and a sheet-metal covering for the roof.



Big Chemist's Retort Built for Movie

Four feet in diameter and more than five feet high, what is believed to be the largest chemist's retort ever made was fashioned from a new plastic material for use in a current motion-picture scene. In the film, a magician "creates" a full-grown woman inside of what appears to be an empty glass retort. The scene is shown above.

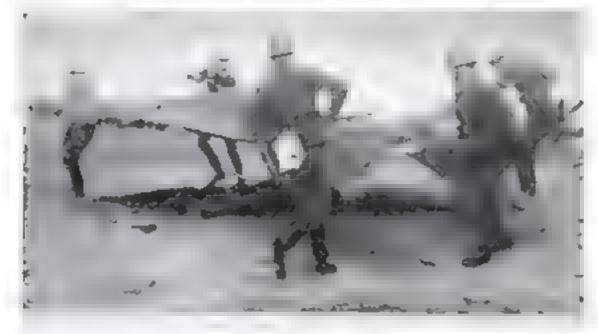
Rack Protects Food from Poison Gas

SUPPLIES of food and drink can be protected from contamination by poison gas in case of wartime air raids by a novel and inexpensive device developed by M. Jaffe, a British inventor living in Liverpool, Food is placed on a raised wire platform and covered by an inverted mixing bowl, bread box, roasting pan, or other nonporous kitchen utensil. By means of two long wire handles, the covered food is then lowered into four or five inches of water standing in a basin or in the kitchen sink. The water forms a perfect air lock inside of the improvised food protector, making it impossible for gas fumes to seep in. With the device, it is said, one minute is aufficient time to protect a supply of food which could be consumed without fear of contamination or pollution after the danger of the gas raid had passed. Larger units could be used for protecting food in hospitals and other institutions.



Food on the rack is set over water and then covered

Pits Conceal Antitank Guns









German soldiers covering a pit to concept on antitant gun. The pit not only concepts the gun crew but protects them from shrapnel

Self-Cleaning Comb Curls Hair, Too

AS A MEANS of protection against tank attacks across open terrain, German military authorities are reported to have constructed a series of sunken, antitank-gun nests in flat areas along their western frontier. The tops of the pits are camouflaged with a cover of brush and leaves, as shown above, so that enemy tanks will be lured unsuspectingly within effective gun range.

SELF-CLEANING properties are attributed to a novel new comb which has specially designed teeth that extend on one side of the comb hearly to the back edge, as shown in the magnifying-glass photograph above. In addition, the makers claim that the comb tends to curl straight hair and to increase the life of permanent waves.

Liquor Flavors Growing Melons

FLAVORING growing melons with port wine and cognac is the novel horticultural experiment being tried on the Yonkers, N.Y., estate of Samuel Untermeyer, New York lawyer. Bottles of the beverages used are held in a tipped position by wire frames stuck into the ground near the melon vines. A wick leading from each bottle is introduced into the fruit through a slit made in the plant stem. Thomas Quinlan, a gardener on the estate, is shown examining liquor-fed which are said to be given a superior flavor.



Wicks feed the liquor from bottles into openings in the plant stems



Treasure in Peat Moss

EN acres of waste land, on the outskirts of

By CARL WARDEN

kins dug down. He found a solid layer of sphagnum moss ex-

a small New England village, have become the scene of a singular mining boom. With a hand cultivator, a barnyard conveyor, and machinery run by a discarded automobile engine, David M. Perkins, of Center Barnstead, N. H., has excavated more than 200 tons of "pay dirt" from the spot. His treasure is neither gold nor gems nor granite. It is brown, spongy earth. For, his waste-land plot is one of the few peat-moss mines in America.

This material, the product of centuries of slow decay, is so valued by gardeners and poultrymen that more than \$1,200,000 worth is imported annually. Virtually all the peat moss used in America comes from abroad. With the war interfering with shipping, the discovery of new domestic sources of supply is of special interest.

A curious chain of circumstances led Perkins to the discovery of his mine. Two years ago, he and his father purchased the tract on the edge of Center Barnstead for the purpose of establishing a commercial trout

pool. They intended to excavate the hollow.

turn it into a lake, stock the water with game fish, and then charge anglers a fee for fishing there.

In preparation for the digging, they began clearing the site of bushes. The work had not progressed far before they noticed a peculiar thing. The ground was so spongy that fairly large bushes could be pulled up by hand. Per-

tending as far as three feet below the surface. Underneath was brown, spongy material unlike anything he had ever seen. He scooped out some and sent it for analysis to the state university at Durham, N. H.

A week or so later, one of the scientists from this institution drove down to Center Barnstead. There are only 400 inhabitants in the village and he had little difficulty finding Perkins. He reported that the samples Perkins had sent in were high-grade peat moss. He was interested in examining the site where the peat had been found. Together, the men dug and made borings. In some places, they found, the peat moss descended for more than twenty feet.

As a double check, Perkins forwarded other samples to the U. S. Department of Agriculture, in Washington, D. C. The report that came back indicated that his peat moss was ninety-eight-percent pure organic matter. As no stream ever flowed through the bollow, there is virtually no foreign matter, such as sand or gravel, in the peat.

Among its many uses, peat moss is em-

Planning a
Fishing Pend, an
Observant New England
Villager Stumbled Upon
a Curious Field of
"Pay Dirt"



Top layer of the moss that goes down to a depth of twelve feet



valuable for other purposes.

Tests have shown that peat is an efficient insulating material and that peat dust is an exceptionally effective deodorizer. And, other experiments have indicated that peat formed from sphagnum moss has absorbent and antiseptic qualities which make it an excellent substitute for medicated cotton in

aurgical dressings.

Nobody knows how many centuries have passed while the Center Barnstead hollow has been filling with its successive layers of moss. So far, in his one-man mining operations, Perkins has opened up only about three quarters of an acre. More than nine tenths of his store of peat moss remains untouched. And, where operations have begun, only a thin upper layer of the brown material has been removed.

In "working" his mine, Perkins first pushes a hand cultivator back and forth across the open space, ripping up the spongy peat. Then, he shovels the loose material into a conveyor supported by an overhead cable, and transports it to a metal-covered, barnlike processing shed. Just outside the building, the peat is dumped in a great mound. Later, as it is needed inside, it is shoveled onto an endless-belt conveyor which carries it through a window and into a shredding machine, the first of several mechanisms which prepare the material for market.

In one corner of the long shed, a gasoline engine—obtained from a junk automobile—thunders away, supplying power for all the machines in the one-man plant. It moves the conveyor which brings the peat into the building, it whiris the spinning arms of the shredding machine, it operates the presses that remove excess moisture, and, finally, it powers the pulverizers that turn part of the peat moss into powder for special purposes. The final product, cleaned and prepared for market, is sold in sacks. Wholesale, the peat moss brings twenty dollars a ton—or quite a profit for "worthless land."

Fashion Plates Adopt Armor Plate





A Landoner trying on the latest in bulletproof vests. Right, being measured for a steel-lined bowler

EN'S shops in London are now stocking a new line of merchandise for sale to customers who want special protection during possible enemy air raids. In their clothing departments, the stores are offering bulletproof waistcoats, or vests, in all sizes

and in a wide variety of styles. Hat departments are keeping pace by supplying the traditional English bowler, or derby, specially fitted with a steel lining that makes it as protective against flying fragments as the metal helmets issued to soldiers.

1639

Fred Mantgamery checking new additions to the University of Kansas library of rare movies

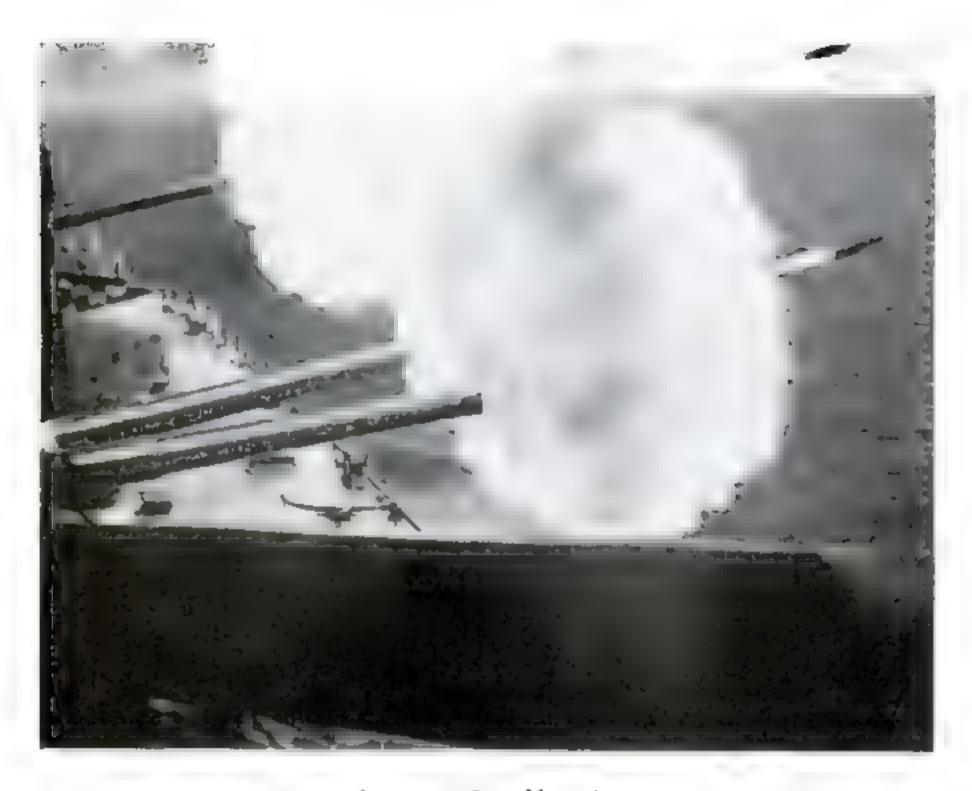
Rare Motion-Picture Films Form Bookless Library

A BOOKLESS library that is stated to be the largest of its kind in the world is maintained at the University of Kansas, at Lawrence. Instead of books, the library contains prints of old motion-picture films. In the photograph at the left, Fred Montgomery, who is in charge of the collection, is shown looking over part of a recent shipment of 250,000 feet of film.

Traveling Case for Bottles

MADE of a suedelike material, a new bottle protector was designed especially for travelers. Built for medicine and cosmetic containers, the bottle bag has a perforated lining filled with absorbent gauze and cotton, which not only cushions the bottle to prevent breakage, but also soaks up any liquid that may leak out while the bottle is packed away.





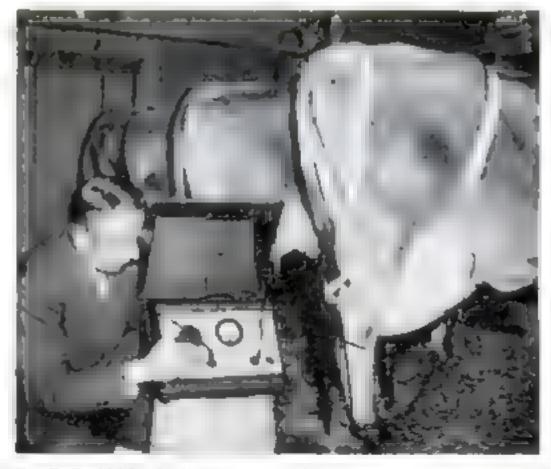
Camera Catches Shells from Big Guns

SHELLS fired from the big guns of a British battleship during gunnery practice off Portsmouth, England, not long ago, were caught by a camera just as they left the gun muz-

zles, as shown in the remarkable photograph reproduced above. One shell is visible at the center right of the picture, and another at the top right.

Cows Get Treatment by Heat Radiation

CATTLE are given special heat treatments for the cure of various ills by means of an electric-therapy machine developed for animal use by Dr. E. D. Hildreth, professor of bacteriology at Ohio State University at Columbus. Plugged into an electric outlet, the apparatus creates short-wave radiations which are passed through an ailing part of the animal's body. Two electrodes are strapped on opposite sides of the affected part and the radiations pass between them, creating a soothing and curative internal heat. Dr. Hildreth is pictured at the right demonstrating the machine on a cow.

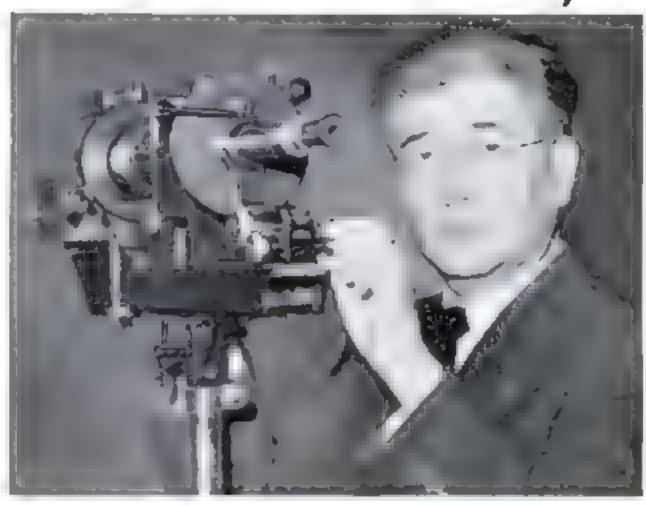


Dr. E. D. Hildreth demonstrating his heat treatment for cows

Inventor Hides Secret of "Death Ray"

PIGEONS on the wing instantly killed by death rays from a machine four miles away—that is the feat reputedly accomplished by a deadly apparatus developed by Dr. Antonio Longoria, of Cleveland, Ohio, who recently announced that he had deliberately destroyed the lethal machine for the good of humanity. The Cleveland inventor declared that he had atumbled on the deadly rays while experimenting in the treatment of cancer with high-frequency radiations. The action of the fatal rays, he declared, is painless and they work by changing the blood into a useless

substance, much as light transforms silver salts in photographic processes. Before a group of scientists, it is reported, he once demonstrated that the radiations would kill



Dr. Antonio Longoria, who vows never to reveal his secret of the "death ray"

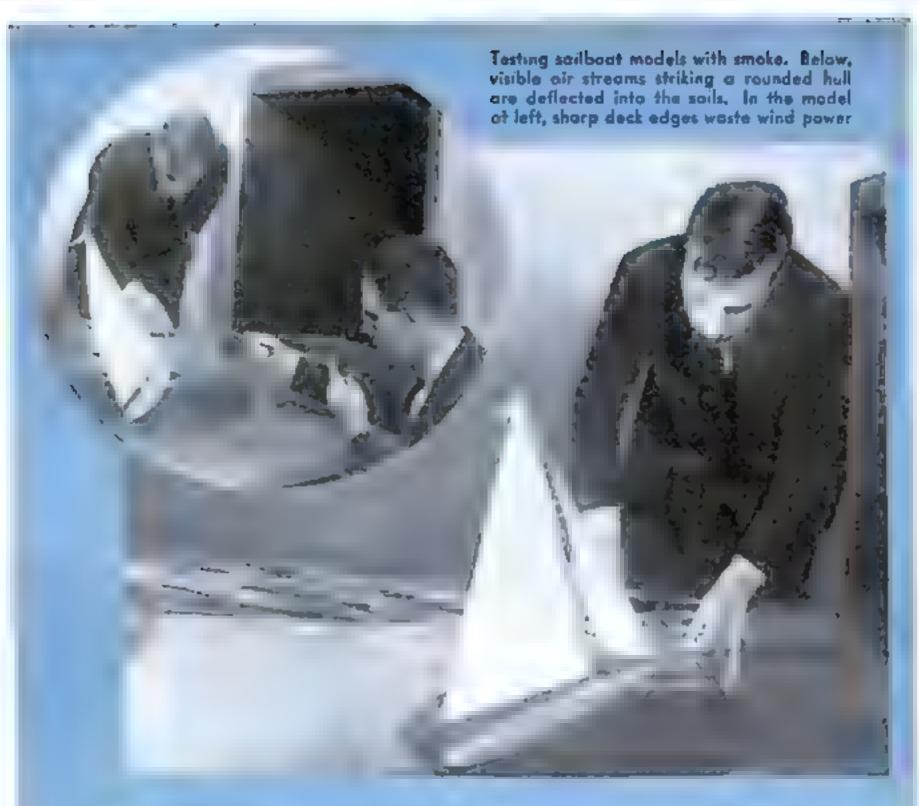
rats, mice, and rabbits, even when the animals were incased in a thick-walled metal chamber. The rays, Dr. Longoria believes, could kill human beings just as easily.

Water-Filtering Plant Is Portable

LIGHT enough to be carried by one man, a portable filter outfit recently introduced is designed to insure a clean, clear, and uncontaminated supply of water to woodsmen, surveyors, explorers, and other groups who must rely on water of unknown quality. Fitted with a hand pump for drawing water from a river or lake, the apparatus will work successfully with practically any type of filter material to deliver five gallons of filtered water a minute.



Portable filtering plant in use. A hand pump draws water from a stream or take. Left, how the forty-pound outfit can be carried



Smoke Tests Guide Sailboat Design

GREATER sailboat speeds may be posaible by rounding the deck edges of the craft, according to novel wind tests made at the Casa School of Applied Science, Cleveland, Ohio. Controlled streams of air, made visible by the introduction of smoke, showed that rounded deck edges directed more wind into the sails.

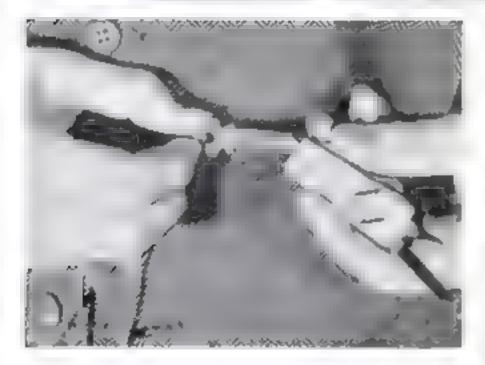
Wire Loops Hold Visor on Ski Cap

HELD in place by tiny wire loops that resemble hairpins, a visor developed by a California ski enthusiast is easily attached to the peak of a ski cap. Made of a green celluloid material, the visor not only affords protection from the glaring rays of the sun, but when pulled down, prevents wind from rushing directly into the eyes of a skier as he travels downhill at top speed. When not needed, the visor may be pushed up out of the way, or it can be removed and kept in a pocket if desired.



Stilt Bike Gives Second-Story Ride



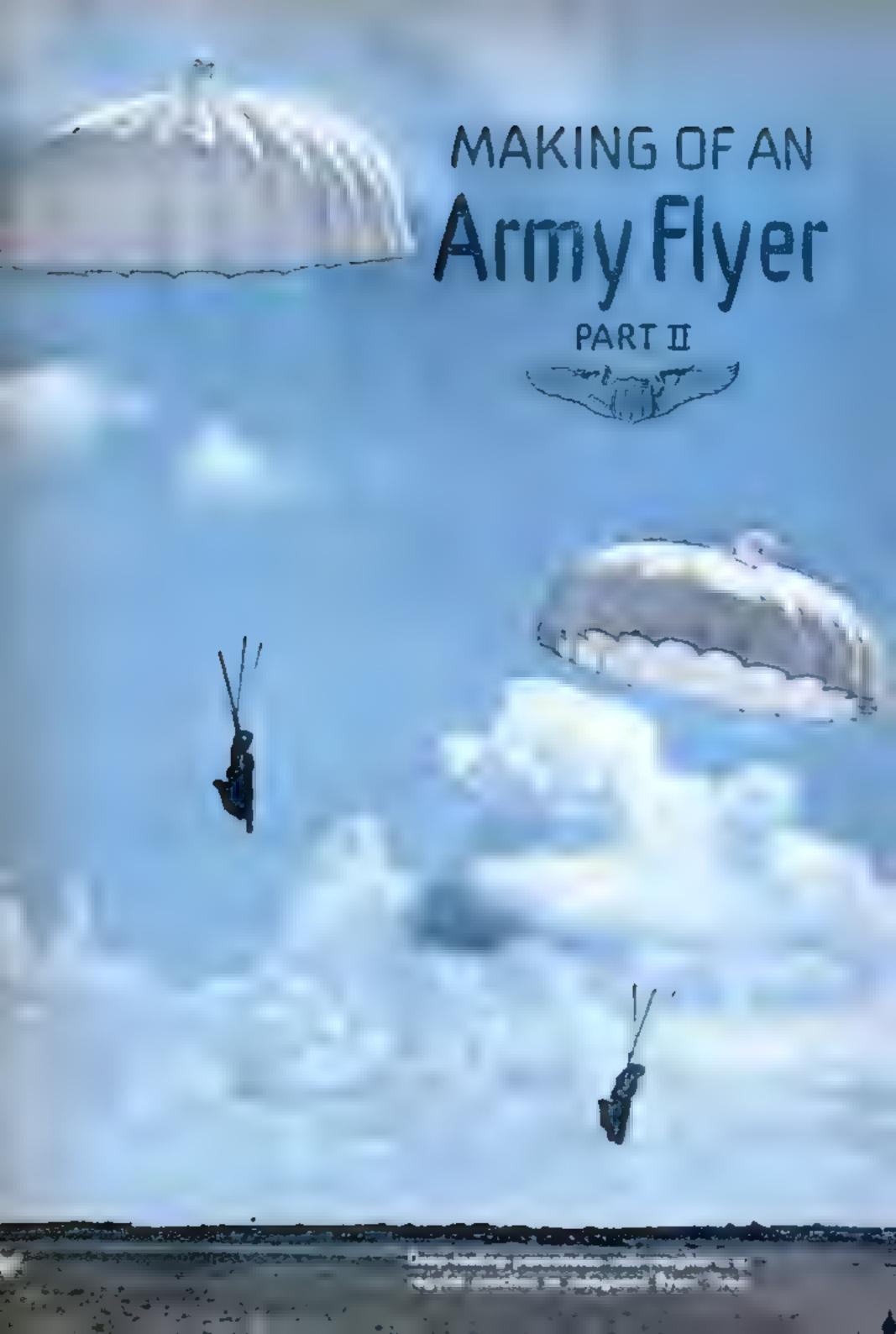


The key slips easily into the end of the knife

Knife is Holder for Key

NAIL FILE, knife, and a key blank that can be cut to fit any lock, are combined into a single pocket unit now on the market. The key slips into one end of the knife, one blade of which serves as a nail file as illustrated in the picture at left.

WHAT did you like best in this issue of POPLLAR SCIENCE MONTHLY? Your answer may win a prize. See "Our Readers Say" for details of this interesting letter contest.



CADET RICK JONES LEARNS ABOUT NIGHT FLYING AND HAS HIS FIRST EXPERIENCE WITH THE "JEEP"

HE night was black and moonless, but as Flying Cadet Rick Jones sat at the dual controls of his sleek Army BT-9 monoplane, it looked to him as if he could reach up and pick a handful of stars

right out of the clear Texas sky.

His preliminary Air Corps training behind him, Rick was now a student at Randolph Fleid, the great university at which the U.S. Army prepares men to man its modern fighting planes. Tonight he was trying his hand at guiding his ship safely through the darkness.

Two thousand feet below, the giant landing field was the size of a pocket handkerchief. The borders were outlined in green markers and red obstruction lights, while in the center of the field a faint patch of light showed the area swept by the landing flood-

lights.

The roar of the motor was sweet and even. the BT-9 responding to the controls with a smooth precision. Compared with the light PT-13 of his early training, it seemed like driving a fast racing car instead of a truck. At times he was almost frightened at so much power under his throttle, but now he was getting the feel of the ship, Three nights of dual flying with his instructor had given him confidence.

"He's giving me a free hand this time," he thought, missing the occasional reassuring pressure on the controls-then realized that only a sandbag ballasted the rear cockpit: that his instructor was down below in the glass-windowed control tower, with the dispatcher and other instructors whose cadets were soloing tonight. Down there, he knew, keen Army eyes were watching, weighing him, testing his value to the nation that was giving him its best here at the famous "West Point of the Air."

From time to time, in the distant sky, tiny red and green lights moved and disappeared. Seven other cadets were practicing, each in his own quarter of the sky-three with Jones below the 2,000-foot level, four safely above 2,500.

In his headset a hoarse voice rose above the static: "Lower Zone 2, come in for a landing." Atop one of the hangars flashed two parallel lines of red lights.

Rick flicked the radiophone to "Send" position and replied into his microphone: "Lower Zone 2 to Tower, Received O.K." Heading back in a descending spiral







A 8T-9 in the air of night, snapped from another plane. This type of plane is used for basic training

toward the field, he lost altitude; laid his course parallel to the base of the swiveled wind T outlined in green lights, and descended to 500 feet as he traversed the imaginary "base leg" of his entrance to the field. A square turn headed him straight into the wind. He cut his gun, lowered his "air-brake" wing flaps, and settled rapidly at the correct gliding angle.

Out of the dark rushed the plane, into the slanting glare of the floodlights' diagonal beams. The landing wheels bumped and he was taxing rapidly over the field.

"Good landing. Now roll up your wing flaps and go back to your zone."

Rick cranked the handle of the flap controls, pushed hard on the throttle, and again

raced into the blackness at seventy miles an hour. As the joiting stopped and the field dropped away from his wheels, three red bars flashed from the hangar top and the headset said, "Lower Zone 3, come in for a landing."

One after another, the eight cadets went through their paces in solving night problems, always under the watchful direction of the instructors who rode with them or watched from the control tower below.

Again Rick landed by the aid of a 300,000-candle-power parachute flare, hurrying to reach the ground before its unearthly brilliance failed. Then came the most

formidable problem of all—"wing-tip" landinga, guided only by the beams from the lamps sunk into recesses in the leading edge of the monoplane's wing. To make the sudden drop down into nothingness, down toward a hypothetical landing field that was merely a square black hole, was like jumping blindfold from a high springboard. The red line of marker lights rose and fell on the horizon as he dipped and raised the nose of the plane. Then a gray patch as the beams began to reveal the surface of the field. A split second's anxious suspense, a lightning judgment of distance—then the bump of the wheels, a sweep across the field, and off to try it again.

The next day, a new problem was presented



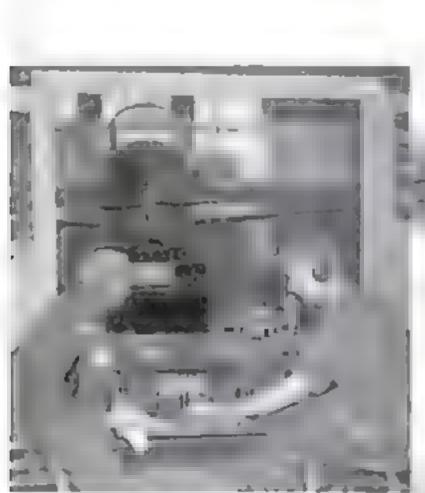
Buzzer practice gives skill in receiving mustages sent in code

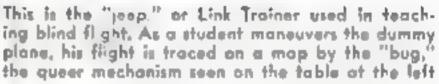
as four G Flight cadets gathered about a table in the hangar annex, looking over the shoulder of the man at the microphone. Across the wide chart upon the table crept the "bug," an instrument vaguely resembling the workings of a phonograph. Upon its three casters it sidled about like an ancient, cautious crab, leaving a narrow ink track in its wake.

From the bug a small cable trailed across
the room to a fat, stubby airplane
known as the Link Trainer, just bug
enough to allow a man to sit in its
cockpit with a metal hood closed down
over its top. The controls and instruments on the dash were genuine, but
instead of their being connected with
the motor and rudder of a plane, the
"jeep" rode on fourteen bellows con-

cealed in its base. When the pilot of this unique craft pulled the stick back, the nose began to lift and the altimeter needle kept pace with its upward "flight."

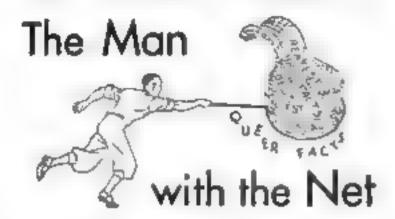
For all practical purposes, the jeep was a real airplane. In it every cadet must get his initiation into blind flying; every Army pilot, regardless of rating, must spend a given number of hours in it each year to keep in practice. (Continued on page 239)





Life at Randolph Field isn't all work, as proved by this view of one of the pools





DEPOSITORS in New York State savings banks have an average west egg of \$915.

UNDER one street corner in New York City there are 560,000 telephone wires.

ALABASTER is a kind of gypsum.

KANGAROOS can scent a man at a distance of four miles.



AVERAGE three-week-old babies can hang by their hands langer than average thirtyyear-old parents.

ROME had a larger population in the first century A.D. than it has today.

NEPTUNE, the planet, has not completed one circuit of its orbit since it was discovered in 1816.

EIGHTEEN HUNDRED brands of automobiles have been put on the American market in the past forty years.

BIRDS in Poland migrated south early, last fall, when German armies invaded the country.



RADIUM has been discovered in some of the dyes used in ancient Navahu blankets.

MAN-OF-WAR BIRDS have a seven-foot wing spread; yet their dried sheletons weigh only one quarter of a pound.

SWITZERLAND has an aperage of sixteen natural springs for every square mile of land within its boundaries.





Gasproof Canary Carrier

CANARY birds kept as pets by one Englishwoman would be protected from gas attacks by means of a novel pushcart while she sought safety in a gasproof chamber. Air from a pump operated by one wheel of the cart enters the glass cage through a gas filter as the wheel turns. If the cart is stationary, the wheel may be turned by hand,

Storage Flash-Light Cell



This cell works just like a car's storage battery

Handy Aids for

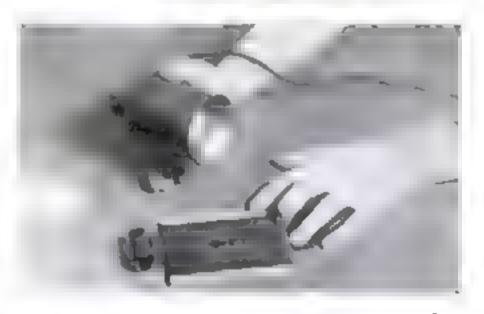
Meter Tests Light for Color Film

RESET by means of auxiliary filters and a special test candle that burns at a known "color temperature" to allow for any error in the color sensitivity of the user's eyes, a new meter shows the photographer whether the artificial light for color pictures is correct for the color film he is using. Since each type of color film is sensitive to a specific color range in the apectrum and every light bulb burns at a given color temperature with a given voltage, the device permits matching the light source to the film sensitivity, by sighting through it while a dial is turned.



New Contact Printer for Small-Size Negatives

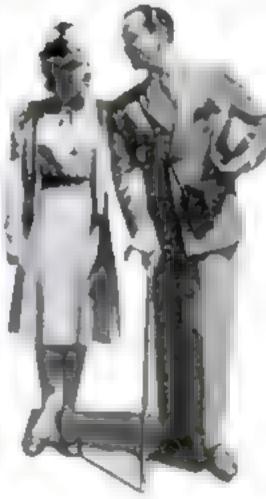
DESIGNED especially for making contact prints from miniature negatives, a new printing frame comes supplied with a 712-watt lamp in a housing that fits snugly over the frame for making the exposure. Inserting the negatives and the film in the frame is accomplished easily, and a convenient switch operates the light. The outfit is compact and inexpensive.



Walking Stick Becomes Camera Tripod



With the handle and tip removed, the cone shown at right becomes a camera tripod



SERVING either as a cane for the strolling photographer, or as a tripod for the picturemaking stroller, the combination accessory shown in the photographs at the left has just been introduced. Made of telescoping steel sections hinged at the top, the three legs form a sturdy camera support when spread apart and extended. Collapsed and folded together, they form the shaft of a walking stick when the curved handle and a special tip are replaced.

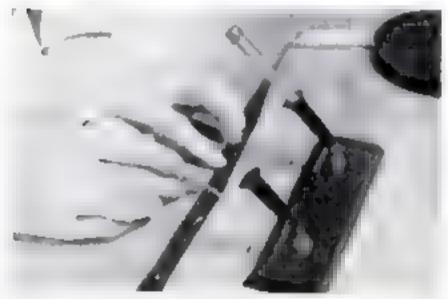
Camera Enthusiasts

Handy New Copying Stand

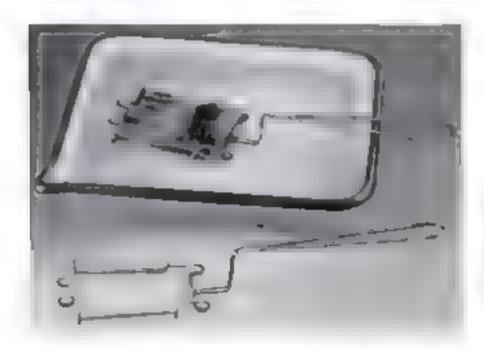
EQUIPPED with a set of extension tubes and lenses and a ground-glass for focusing, the miniature-camera copying stand at the right makes it easy to photograph small objects or flat work at close range. A wooden baseboard supports a vertical tube which holds the camera by an adjustable arm.

Movie-Editing Desk Set

Like a pen-and-pencil desk set, a new aid for amateur-movie editors holds an emulsion remover and an adhesive applicator. In use one instrument releases water, the other adhesive, a drop at a time.

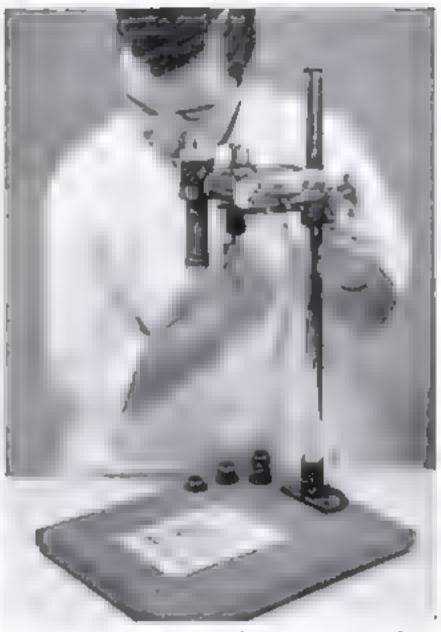


This set keeps two splicing tools always at hand



Rack Holds Single Film

For developing single pieces of cut film or film from a pack when it is not desired to use a tank, the stainless-steel-wire holder shown above holds the film safely by the edges and prevents contact of any part of the film with the tray. It is available for several sizes of films.



A micrometer screw is used to get a sharp focus

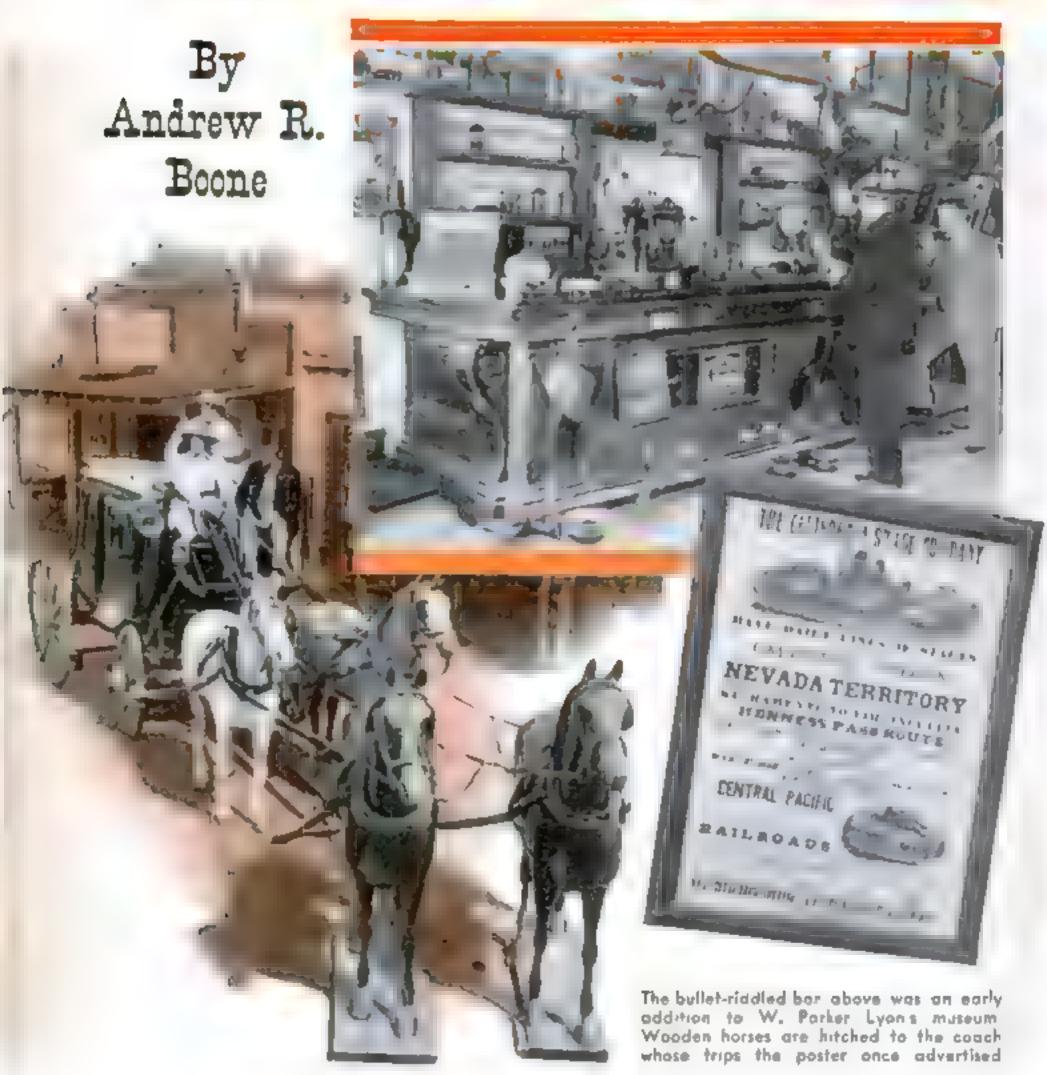
File for Transparencies

LAMINATED cardboard pages that fit into loose-leaf binders for storing two-by-two-inch mounted transparencies offer a novel filing system for your miniature films. Each panel holds twelve transparencies firmly sandwiched between heavy paper-board frames open both front and back for quick viewing and selection for projecting.



Transparencies filed in the book are easy to view

Ghosts of the Wild



ANK MONK shoved his old Concord stagecoach from Hangtown, Calif., across the mountains to Virginia City, Nev., and Bill Cody lashed his horses between Leavenworth, Kans., and North Platte, Nebr., little thinking that future generations would gaze with admiration upon their bullet-riddled, six-horse mud wagons. Pony-express riders, galloping at

top speed across prairies and mountains, helped build civilization in the West with an eye to the future, yet seldom sought personal fame

But one man, inspired by the West's dramatic history, started a quarter century ago collecting every item he could find of the pony-express and gold-rush periods. Each year he adds newly discovered "originals"

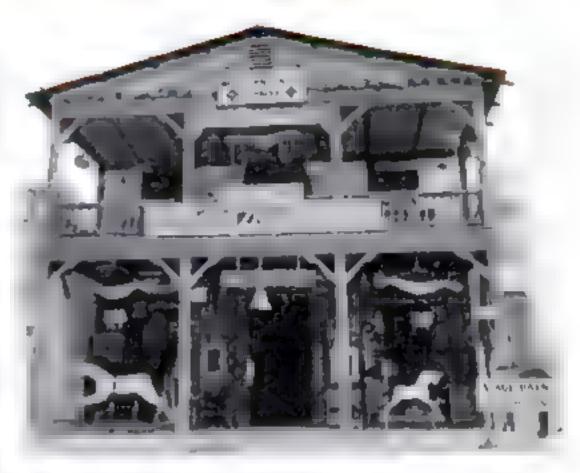


COLLECTOR RE-CREATES FRONTIER DAYS IN ODD MUSEUM

as he pokes about the ghost towns of Nevada and California and scours the communities, both thriving and abandoned, where once the stage lines ran. At his Pony Express Museum, in Arcadia, Calif., W. Parker Lyon displays nearly 1,000,000 items, from pony-express saddles to tomahawks, wooden Indians and wooden horses to a petrified forest.

Lyon has poured more than \$500,000 into his novel museum. Five stagecoaches represent the vehicular phase of western passenger transportation. Freight wagons and fire engines from ghost towns, the thriving mining camps of yesteryear, tell of building booms and efforts to save property from flames. Many interesting relics give us a picture of the hard life men knew in the

early days of the West. Gambling paraphernalia, square nails, patent medicines, paper and celluloid collars, high laced shoes of the 1860 flappers. From Hangtown, Bed Bug, Rabbit Creek, Murderer's Bar, Onion Valley, Rattlesnake Bar, and Rough and Ready. You don't know them today. Hangtown became Placerville. Bed Bug is Ione.



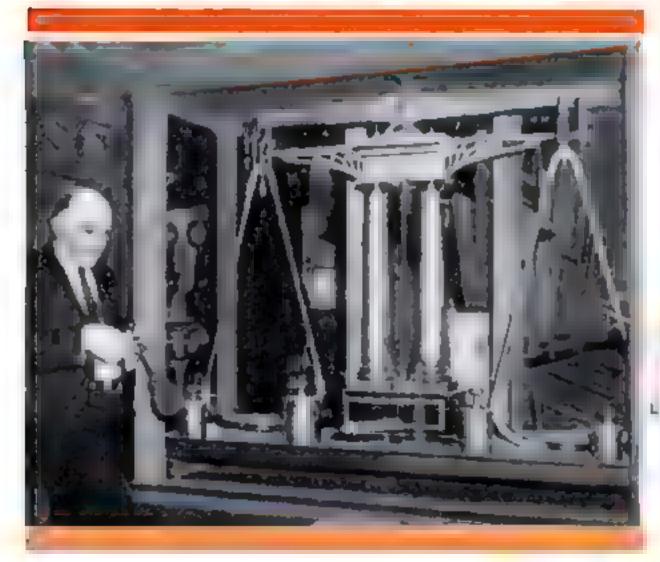
Entrance to the Pony Express Museum. It is a copy of the station and general store at Sanama, Calif., as it looked in 1850

Rabbit Creek transformed into La Porte.

A simple incident led Lyon to establish the museum. An active stamp collector some twenty-five years ago, he drove his huge old automobile from Pasadena 500 miles north seeking an old stamp. He had heard while on a visit in Europe that the "western franks" were valuable items.

These were not stamps in the accepted sense, but were imprinted directly on the envelope much as a cashler

Extremes in gold scales are the one at left that handles up to 1,000 ounces, and the partable banjo scales below







receipts a bill. Many showed a pony galloping across country, with "Pony Express" printed above it.

Finally locating the Dobbins ranch, up in



Lyon panned \$22 in gold sucked into the machinery of this fire engine found in an empty ghost town

the mountains of Yuba County, where he understood a rare express stamp could be bought for \$65, Lyon found not a stamp but the stagecoach which Hank Monk once drove between Hangtown and Virginia City. "I kept thinking of all the famous characters of western history who might have ridden in that coach," Lyon often relates, "and the more I thought about it, the more that hard-riding buggy appealed to me. Well, I bought the coach instead of the stamp, hooked it onto my car and drove home."

That was the first item of his museum. The second, acquired not long afterward, was a fifteen-foot bar which had been brought around Cape Horn to California in 1849, and served a checkered career in the vicinity of Mariposa. Five bullet holes, said to have been shot through it by a sheriff attempting to capture a man, give it added interest. Over it hangs this placard:

"This builet-scarred bar is historical. Gen. Fremont, U. S. Grant, Mark Twain, Bret Harte and Joaquin Miller drank gallons of red liquor over its polished top in the early fifties."

Anything belonging to the old West will find a place in this collection provided Lyon

can find it. He seeks only originals, and travels thousands of miles yearly in his station wagon, which often returns to the museum heaped high with everything from stoves to bath tubs.

Some surprising objects turn up as Lyon pokes around towns and pursues rumors. At Dayton, Nev., recently he bought an eighty-four-year-old fire engine. Some days later, when chipping away pieces of black sand and gravel carbonized in the suction machinery, he came upon several gleaming yellow flecks resembling gold. Twenty-two dollars worth of the prized metal was panned out of the long-incrusted ore.

On another journey, he found a wooden horse in a livery stable at Truckee, Calif This gave him the idea of hitching a team to one of the old stageographes and

to one of the old stagecoaches, and before returning to Arcadia, he had rounded up nine of them

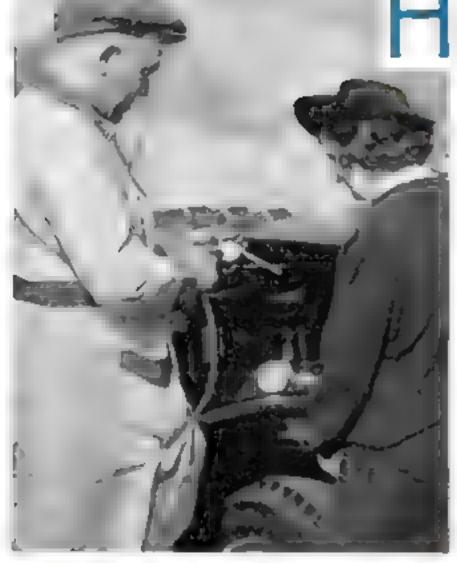
Up in Calaveras County while seeking a wood stove, he found a twelve-foot muzzle-loading shotgun, used by some pioneer to shoot game across wide canyons. Far too heavy to be held against the shoulder, it was fired on a rest, its butt backed up against a tree.

can bring home in a single load. On one of his junkets he found the largest gold scales known in the west. The scales, made in 1858, were capable of weighing 1,000 ounces of gold or silver, and were so delicate a fly would unbalance the pointer.

Other strange relics include fifty safes, most of them former Wells Fargo depositories; a revolver fitted into a tree stump which, attired in a hat and coat, served as a dummy "accomplice" in almost forgotten stagecoach robberies; a small cemetery; a one-cell jail; a barber's chair bearing blood stains of a man shot dead in it; and a hotel menu listing a moderate dunner at \$5.75.



How Good



Jack Fletcher explains a special gauge to a client for whom he is testing a used car BEFORE she buys

You Can Find Out for Yourself Using the Simple Methods That Set Jack Fletcher Up in His Own Remarkable Business of Advising Automobile Buyers

By JOHN EDWIN HOGG

STEERING GEAR: See that all four tires are evenly inflated. Point the front wheels straight ahead. Now rock the steering wheel back and forth, holding it with the thumb and finger tips. Free movement of

the wheel in excess of two and a half inches before the front wheels begin to move is a sign of worn mechanism or a steering assembly too loose for safety. Repairs here are expensive,

FRONT-WHEEL ASSEMBLY: With wheels pointed straight ahead, stand beside a front wheel, grasp the top of the tire firmly and shake the wheel with a pushing and pulling motion. A slack feeling or a clatter indicates wheel bearings, king-pins, or both are loose. Loose front-wheel assemblies cause faulty steering, shimmy, and abnormal tire wear. Proper repairs will cost from \$7 to \$22.

MOTOR: Check the oil while the motor is at air temperature. Oil on the gauge blade should not be heavier than SAE 30 or 40. If you find heavier oil, demand that it be changed to a lighter grade before your demonstration drive. If the oil is O. K., examine a "clean motor" for oil, water, and compression leaks after running the motor until it is heated to normal driving temperature. When the motor is running hot, speed it with short, heavy thrusts on the foot throttle and watch for bluish-white smoke from the exhaust. If the motor smokes, oil is leaking past the piston rings. This means faulty piston rings, worn pistons, and, perhaps, cylinders in need of reboring. Remember that motor overhauling is about the most expensive form of automobile repairing.

STARTING MOTOR: With the ignition off, step on the starter for about ten seconds. Repeat this three or four times. Broken, burred, or badly worn teeth in the flywheel starter gear will clash and grind or keep the gears from engaging. Proper repairs cost from \$3.50 to \$30.



promises trouble or bis

Is a Used Car?

N 1933, Jack Fletcher, a Los Angeles, Calif, automobile mechanic, was earning little or no money at his trade. Today, he is the proprietor of a thriving business that helps his customers get their money's worth when

they buy a used car.

How did it happen? The idea came to him after he learned that more than half the cars on the road were bought second-hand. He'd been a mechanic long enough to know that few motorists knew very much about their cars beyond what they saw on the surface. He also knew that plenty of those second-hand-car buyers had been stuck

'I've got it," he told his wife. "In thirty days I'll be working eight hours a day."

It was probably longer than thirty days before his prediction came true, but he stuck at his idea, and today it's true and then some! For daily to Fletcher's office come used-car buyers. His job is to examine inside and out the cars they buy—before they buy them. It takes two hours, and his fee is \$10.

Fletcher's files contain long lists of car' models and records. Pick any car produced since 1920, and he'll tell you what its life expectancy is. His clients usually select the car they'd like to buy—following his auggestions on how to judge them—and then he goes into action.

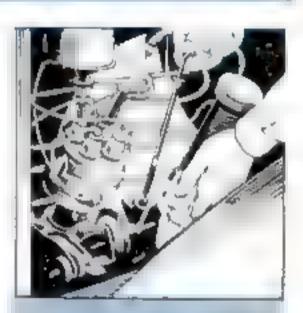
Are you planning to buy a used car? Then it will pay you to make use of Fletcher s easy tests given on these pages. They will help you to separate the "good buys" from the "lemons," and you don't have to be a skilled automobile mechanic to use them.

CLUTCH: Standing outside the car, depress the clutch pedal with the finger tips. You should find about half an inch of practically free motion. If there is no free motion, the clutch may have been burned by slipping or so badly worn as to need relining. Correct free movement of the clutch pedal, however, does not necessarily indicate a clutch in good working order; the pedal may have been reset. A reliable clutch inspection can be made only by auto mechanics. Lasting clutch repairs cost from \$6 to \$28.

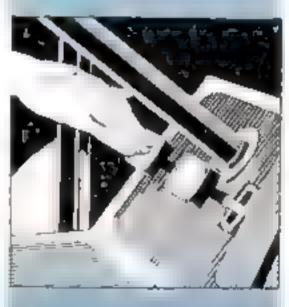
BRAKES. Sit behind the steering wheel and press the brake pedal down firmly. If the pedal goes to the floor, the brakes are not properly adjusted and may need relining. To test hydraulic brakes, press the brake pedal down and hold it down firmly for at least thirty seconds. If the pedal slowly sinks, the hydraulic system is defective. Proper brake repairs may cost up to \$24. Remember, too, that any old brake lining or worn linings bushed with strips of asbestos will make very defective brakes hold temporarily. YOUR LIFE AND THE LIVES OF OTHERS WILL BE ENDANGERED BY FAULTY BRAKES!

TEST FOR MOTOR ADJUSTMENT: With the car in high gear, slow down to ten miles an hour (with slight pressure on the brakes, if necessary). Release the brakes and accelerate quickly to full throttle. If the car gains speed quickly and smoothly, without choking, sputtering, or bucking, you may be fairly sure carburetion, valves, valve guides, and ignition are functioning properly.

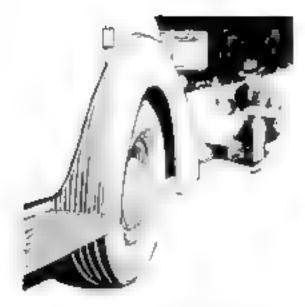
TEST FOR DRIVE ASSEMBLY: With the car in low gear, speed up, apply the brakes, and shift into reverse as quickly as possible. Repeat this several times. A worn clutch will slip or engage with a jerk. If warped or out of alignment it will shudder, squeal, or chatter. Excessive wear in transmission gears, universal joints, and differential will appear as slack or lost motion if the car does not respond smoothly to the change of motion forward and backward,



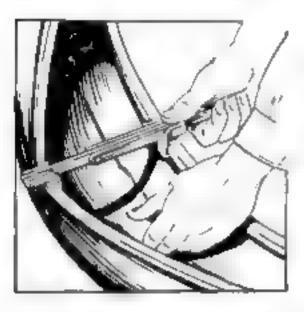
Heavy engine of covers a multitude of sins—and of knocks. Be sure it's light enough before you listen



Initial clutch test. Press dawn pedal with fingers, A half inch of play is about the right amount



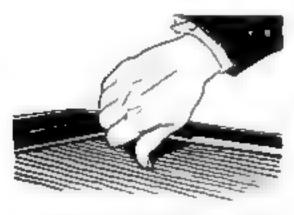
Get behind the maving car and make sure the wheels track. If they don't, don't buy that carl



The only way to tell if a tire is safe is to have an expert remove it and examine the inside



When the new models come out, used-car prices drop. So that's the cheapest time to buy one



If the car hasn't an all-metal top, test the fabric with your thumb. New tops are expensive

TRANSMISSION AND BEARINGS. With the car in low gear, speed up quickly to twenty or twenty-five miles an hour. Loose motor bearings will knock and a worn transmission will squeal or grind. If there is a hill near-by, coast down in high gear with the clutch engaged, brakes free, and the foot off the throttle. Under this test any abnormal motor noises are accentuated and a worn transmission clatters.

winds, drive at about twenty-five miles an hour on a smooth, flat road. Take your hands off the steering wheel and watch the car's performance. It should go fully 100 yards without any tendency to drift off the road. Any pronounced drift in this distance indicates that the steering mechanism may be excessively worn or out of adjustment, wheels may be out of line, axles bent, springs sagging, or the frame of the car out of alignment from crash damage. Lasting repairs for correction of these troubles are expensive.

as fast as you can safely make a right-angle turn, turn sharply to the left and right several times to see if steering gear binds at any point. Attempted adjustment to overcome excessive wear will create this dangerous condition. There is just one remedy: a coatly steering-gear rebuilding.

REAR AXLES AND TRANSMISSION. Take out the seat cushions. On a smooth, quiet road, accelerate and slow down gently, and then let the car coast to a stop with the foot off the throttle and the gears in neutral. If, in making these tests, you hear any pronounced chatter, rumble, or grinding sound, you can be sure of facing an expensive overhaul. If the car has hypoid gears, reject it if these tests produce any suspicious noise at all.

to twenty miles an hour and apply the brakes while maintaining the speed by feeding more throttle. Don't stall the car with the brakes until the throttle is clear down. Disregard sharp, pinging carbon and spark knocks and listen for a muffled, hollow knocking in the motor. You should hear this knocking in all cylinders. If the knocks are not all very similar, it indicates one or more loose bearings. This is admittedly a drastic test, but if you hope to drive long distance at high speed, reject any car that cannot meet it.

that will not check speed without chattering, squealing, grabbing, or causing the car to swerve from its forward course. Brakes are particularly important if you expect to drive on mountain roads or in any very hilly country. Brakes that are entirely satisfactory for city driving often fail completely when subjected to the heating of frequent braking on long grades. Inferior linings or "shimmed," worn linings will fail in any severe down-grade test. This test, however, should be discontinued with the first indication of brake weakness.

SPRING SHACKLES: If a car is stiff and jiggly when driven at about twenty miles an hour over slightly uneven pavement, look for worn spring shackles concealed by excessive tightening. On the other hand, if shackles are worn and loose, you'll hear them clatter if you drive the car over a stretch of "washboardy" or cobblestone road, or any piece of neglected pavement.

RESPONSIVE MANEUVERABILITY: Road-test the car by driving at about forty miles an hour upon fairly rough road. If it has a tendency to plunge, swerve, or shimmy, or if the front wheels "tramp," or bounce rapidly, your safest course is immediate rejection.

GENERAL PERFORMANCE: Sluggish pick-up on a level road or slight grade, together with a sharp pinging in the motor may indicate one or more defects—a motor heavily loaded with carbon, faulty ignition, faulty valves, or improper carburetor adjustment. If a dealer submits a car for testing in which such defects are present, you may be sure they are deep-seated and cannot be remedied cheaply.

a smooth, straight road while you watch from the side. Watch for wobbling wheels and listen for unnatural sounds such as muffer and exhaust-manifold leaks, rattling transmissions, and body squeaks. Watch the wheels from behind to see how they track. Wobbly wheels indicate bent axles, damaged wheels, or faulty spindles—any of which will cause

excessive tire wear. If rear wheels fail to track behind the front wheels, reject the car. It's not worth buying.

ROAD-TEST OBSERVA-TIONS: Having found a car that appears to be a good buy, ask the dealer to let you drive it at least fifty miles. This is the only way you can check oil and gasoline consumption. A drive of this or greater distance over as wide a variety of roads as possible will also usually bring to light possible defects that are not readily apparent. And if the dealer is honest and has nothing to conceal, he should be glad to help put across a sale by giving a serious prospective buyer every opportunity to buy with his eyes open. You'll probably find him more than willing.

TIRES, TOPS, WHEN TO BUY: Tires retreaded over defective carcasses are dangerous. Have a disinterested tire man inspect the tires anyway. If the car top is not the all-metal type, inspect it closely. A good top job costs from \$20 to \$50. As to car appearance, \$25 will get you a fine paint job, but a spray gun and \$3 worth of paint will not-for very long. A good time to buy a used car is in the fall after new models are announced and used car values decline.



Always road-test an automobile of forty on a rough road. It should neither swerve, wander, tramp, nor show signs of shimmy



Fletcher never neglects an under-car inspection. Any sign of a straightened chassis indicates the car has been in a crosh



Note the wind sock on the painted bowlder

atone palace, complete with private airport, is the home of a California prospector who built it all with his own hands, at no cost save his own labor and a little dynamite.

Jobless, in 1931 Frank Critzer came to the desert 100 miles southeast of Los Angeles on a prospecting trip. While staking out gold and silver claims, he camped under the lee of a tremendous bowlder, tall as a seven-story building, and later conceived the idea of burrowing beneath it. With pick and dynamite he worked until he had dug out an apartment meas-

uring twenty-four by thirty-six feet, divided into two rooms and entered by a long staircase. Necessary lumber he salvaged wherever he could pick it up, hauling it many miles across the sands. His enthusiasm grew as the work progressed, leading to improvements that now include a well-equipped workshop with anvil and forge, and a picnic ground with toilets and lunch tables among the huge rocks studding the hillside above his burrow.

Downstairs, in a corner beneath the windows, is a large stove, fueled by desert kindling be gathers in an annual excursion to near-by Wood Canyon. Curtained off by a heavy rug is the bedroom, where Critzer keeps his rifles and shotgun, his wardrobe, and his library. At the head of his bed is a hole communicating with a tunnel running through under the rock to the opposite side. This forms his air-conditioning system. By removing an old coat from the porthole, Critzer gets good air circulation across the rooms, up and out the windows on the far side. Though the outside temperature reaches 110 in summer and four-teen in winter, the thermometer in his living room never goes above seventy-eight

The prospector welcomes visitors to his stronge house



The lone prospector cleans a lamp chimney in his "living room," scooped out beneath a giant bowlder

Mew Appliances



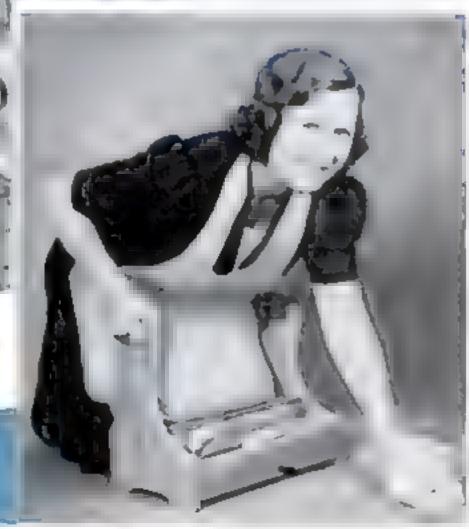


FERRIS-WHEEL SHOE RACK, Eight pairs of shoe trees are mounted on a wheel in the convenient rack illustrated above. To select a pair of shoes, a user merely turns the wheel



SLICING PLATE. A wooden board set in a parcelain plate aids in serving sausage. Note the special knife and tangs for bologna

KNEELING STAND Tooks that require kneeling are easier with the stand at the right. There is a tubber pad for the knees

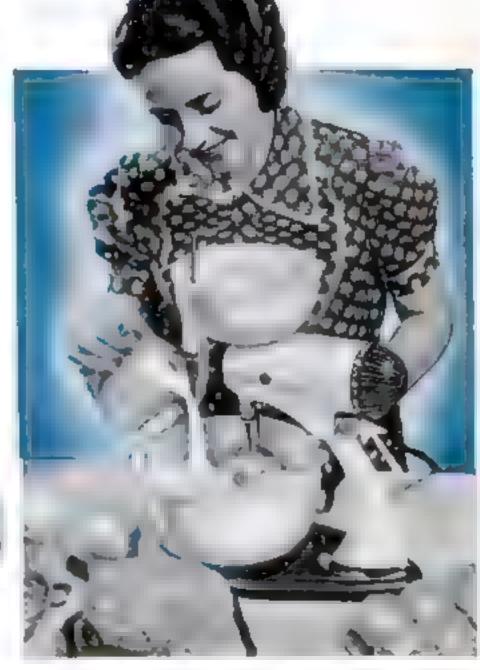


for the Household

MIXING SPEED for the machine at the right is regulated by turning a dial on which various foods are indicated by name

VASE BRUSH. Cleaning longnecked vases and bottles is easy with the brush below. Its sponge-rubber cleaning surface covers a flexible metal tip





ROUND FLATIRON. Circular in shape the plate of the new electric iron at the right covers a large area and speeds flat work



HANGER BAG To beep a guest from forgetting handbog or gloves, the quited silk bog below fits over a coat hanger. Small articles are placed in it when the visitor's coat is hung up



ris on handle show which is which

POPULAR SCIENCE Question BEE

If you can give the correct replies to sixteen of the brain teasers below, you've started out the New Year with a bang! To check up on your knowledge, turn to the answers on page 244



- International law originally extended a country's sovereignty just three miles to sea, because (a) it was the greatest distance at which a vessel's flag could be recognized (b) a strong man could swim that far out and back (c) cannon of that time could shoot no farther.
- 2 The hardest material in the human body is found in the (a) thigh bones (b) teeth (c) finger nails (d) brain.
- 3 A sugar solution will not conduct electricity because it lacks (a) vitamins (b) ions (c) genes (d) hormones.
- 4 The sycamore is also known as the (a) whippletree (b) rooftree (c) family tree (d) plane tree (e) Christmas tree.
- 5 Euclid was the father of present-day (a) architecture (b) medicine (c) radio (d) geometry (e) paper hanging.
- 6 A weir is (a) a dam (b) an oven for pottery (c) the structure at the top of a mine shaft (d) a machine for making coil springs.
- 7 Taxonomists (a) manufacture taxicabs (b) stuff the trophies that hunters bring back (c) classify different kinds of plants and animals according to their relationship (d) study how to levy taxes on a fair and scientific basis.
- 8 The crankcase of an automobile is the place where you should put (a) the crank (b) gasoline (c) emery dust (d) motor oil.
- 9 Microscope specimens often are stained in order to (a) make them look pretty (b) bring out details of their structure (c) kill any parasites that might destroy them.

- 10 Electric cords contain two wires because (a) if one wire breaks, the other will maintain uninterrupted service (b) electric current comes in through one wire and goes out through the other (c) cords with twin wires lie flatter under rugs.
- 11 Tinctures are solutions in which the solvent is (a) oil (b) water (c) alcohol (d) acid.
- 12 Uranium is (a) one of the moons of the planet Uranus (b) a radioactive element (c) the best food for tropical fish (d) an important ingredient of concrete.
- 13 Taste buds are found in (α) florists' shops (b) artichokes (c) the human tongue (d) insect-eating plants.
- 14 An invertebrate is (a) a stunt pilot (b) the mirror image of a geometrical figure (c) an animal without a backbone (d) a person who shows no gratitude for a kindness.
- 15 When fish lay eggs, they are said to be (a) calving (b) molting (c) spawning (d) pollinating.
- 16 Astigmatism is a defect in a person's (a) knees (b) ears (c) spinal cord (d) eyes.
- 17 A good location for the antenna of a television transmitter would be (a) a high place commanding a view of the whole horizon (b) the surface of a broad pond (c) the exact center of a large rotating copper disk (d) the deepest cellar available.
- 18 Cells in bees' honeycombs have the shape of (a) circles (b) squares (c) hexagons (d) triangles.
- 19 "United States standard thread" is (a) the kind of thread found in the paper of dollar bills (b) a widely used type of screw thread (c) sewing thread made exclusively of U. S. cotton.
- 20 Speaking of geography, don't forget that the modern name for Persia is (a) Manchukua (b) Iran (c) Tanganyika Territory (d) Wilkes Land (e) Liechtenstein.

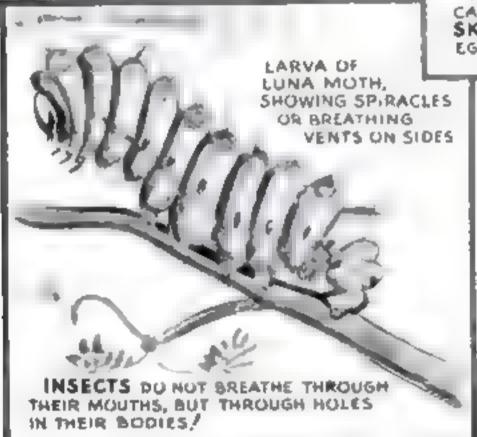
Un-Natural History Gus Magen



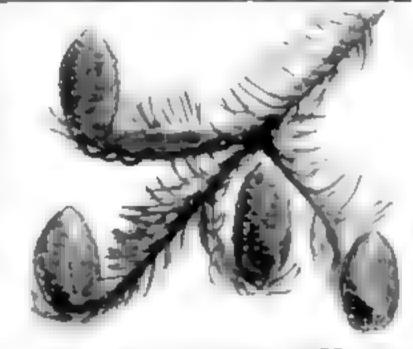
MANY KINDS OF BATS HAVE A NARROW, CONELIKE MEMBRANE IN THE EXTERNAL EAR! IT IS BELIEVED TO INTENSIFY SOUNDS AND AID THEM IN BLIND-FLYING!



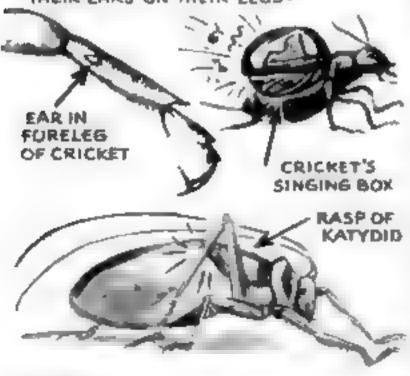
THE MOST LIGHT-FINGERED PICKPOCKET CANNOT MATCH THE FINESSE WITH WHICH SKUNKS HAVE BEEN KNOWN TO SNEAK EGGS FROM UNDER SITTING HENS!

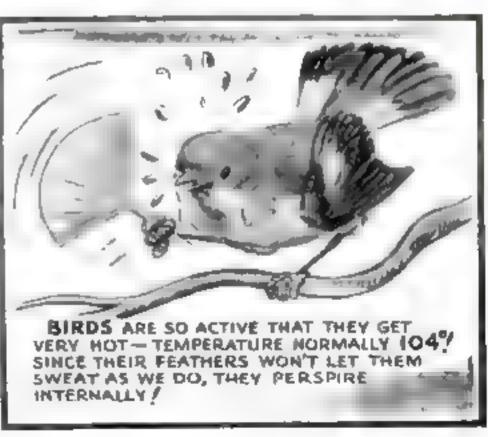


Neither DO INSECTS SING WITH THEIR MOUTHS! THEY HARMONIZE WITH THEIR WINGS, OR WINGS AND LEGS! AND THE ORTHOPTERANS, INCLUDING THE CRICKETS, GENERALLY CARRY THEIR EARS ON THEIR LEGS!



WOULD YOU KNOW A FIR TREE FROM ALL OTHER CONIFERS? THE FIR IS THE ONLY TREE BEARING LARGE CONES THAT CARRIES ITS CONES ERECT!







Gus Shockproofs a Car

OE CLARK came out of the Model Garage office and into the shop looking worried. "What's biting you?" Gus Wilson demanded after he had taken a look at his partner's face. "Are we headed for bankruptcy, or is it just something that you ate for breakfast?"

Joe refused to smile, "I'm worried about those tires I sold Vernon Hopkins yesterday," he admitted. "You know how he is a careful driver, and a little bit of a grouch. He came in while we were having that sleet storm, and said he thought he'd better put on new tires. I wanted to make a sale, of course, but I found his rubber in pretty good shape and told him so. 'Pretty good isn't good enough,' he said. 'I'll put on new tires now and keep the old ones until spring, and wear them out then.'

"That was all right with me, so I sold him a set and had Harry put them on for him. He was on his way down to the city and didn't want to lug the old ones with him, so he asked me to keep them for him.

"He came back late in the afternoon, while you were out, and he certainly was burning up. He said that after we'd put on his new tires he'd gone down to the city and picked up his wife, and that when she'd put her hand on the door handle to get in she'd got an electric shock that had almost

knocked her down. I told him that I didn't see how the new tires could have been to blame for it, but he insisted that they must have been the cause—that he'd never had any trouble with static before, but that ever since we'd put on the new rubber the body of his car had been so full of static that several people who had touched it had received severe shocks.

"To prove to him that it couldn't be the fault of the tires, I had Harry put his old ones back on the car. Then I went out in it alone for a couple of miles, and, when I got back, I told him to put his hand on the body—thinking, of course, that he'd get a shock. But he said he didn't feel anything. So I asked him to drive for a while, and then I tried it. I didn't get any shock, either, so I had to admit that after all the new tires might have something to do with his trouble.

"I got him to let me put the new tires back on, and then I went out and drove his bus around the block a few times. When I got back here he was waiting for me outside, and before I could get out of the ear he had started to open the other door to get in. When he touched it he got a shock that made him hop—and that made him so darned mad he swore he'd never give us another dollar's worth of business unless I took those tires off and gave him back his money.

After a lot of arguing back and forth, I managed to get him to agree to leave the new tires on and bring the car in today so that you could have a look at it."

Vernon Hopkins drove into the shop a little later. The expression on his thin face showed that he still was well charged with bad temper, so Gus judged that his car still was well charged with static—and when he touched it he took a wallop which showed him that he had judged correctly.

Hopkins was talking loud and fast as he got out. "Shucks, man," Gus told him with his disarming grin, "there's no sense in getting yourself all steamed up about a little static. All we've got to do is give it an easy chance to get out. I'll have you fixed up in

three minutes. Take it easy!"

He went over to his workbench and got a carpenter's pencil with a soft, thick lead. With it he drew a half-dozen lines on the inside of each tire, starting at the rim and running across the wall of the tire to its tread. Then he took a little ride. After driving for a mile or so he returned to the garage.

"Touch your hand to the body of the car now," he said. "If you get a shock, Joe'll give you your money back and I'll add a five-spot to it for your trouble. That's fair enough, isn't it?"

Hopkins grunted and touched a finger gingerly to the car body. Then he put the palm of his hand against it, and smiled for the first time that day. "You've killed it," he admitted. "But how, I'd like

to know. Just making marks on the tires doesn't make sense to me, but it seems to work."

Gus laughed. "When I was a grease monkey," he said, "we used to think it was a swell joke to take a soft lead pencil and draw a line from the top of a spark plug down the porcelain onto the head. That made the plug foul out and the engine stall, and the owner couldn't find out why. I figured that if a lead-pencil line on a spark plug would carry that much juice, a leadpencil line on your new tires would ground out the static generated by them."

Gus then used a disk of waterproof graphite to replace the pencil lines with heavier marks which wouldn't wash off. "That'll kill your static devil for good," he assured Hopkins, "and I'll guarantee that he'll never bother you again."

Joe Clark, who diplomatically had kept well out of the irate customer's way, stuck his head in at the shop door after he had driven off. "What did you do to smooth him down?" he wanted to know.

"Oh, I just drew a few straight lines—in the right places," Gus told him. "You can stop worrying, Joe. You won't have to punch the refund key on your cash register for that sale. . . . I'm going down town and get my lunch."

When he got back he found a scratchless and speckless small sedan in the shop, and a formidable-looking stout lady sitting in its back seat. As soon as she saw him she lowered a window and demanded shrilly: "You the mechanic here? Your boss said you'd be back at one o'clock, and here it is almost half past. Well, now you're here, do something! I'm sick and tired of wasting time."

"All right, ma'am," Gus said meekly. "But what is it that you want me to do?"

"Don't ask me!" she snapped. "I don't drive this thing." She poked a scornful fore-finger at a harried-looking man who was coming out of the office, "Ask Mr. Coville—him!"

Coville waited for Gus to come over to

him at the office door—obviously he wanted to stay as far away from the car and its occupant as he could. "I'm having bad trouble with my radiator," he said in a cautious voice, "and my wife is all upset about it. I'm hoping that maybe you can help me out."

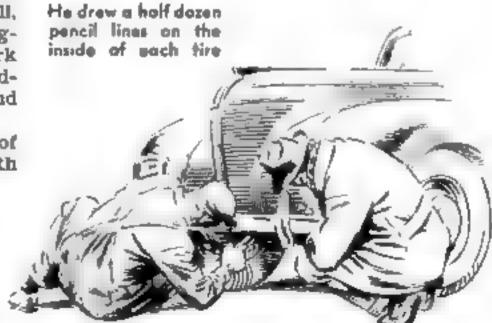
"I'll be glad to. That's my job," Gus told him, "But while I'm doing it, wouldn't your wife be more comfortable in the

office? It's much warmer in there."

The new customer looked more harried than ever. "Yes, she would," he almost whispered. "And I'd be a lot more comfortable if she'd go in there. But she won't. I don't know much about cars, and she knows that I don't. She wants to sit there where

A Customer's Car with a Bad Case of "Static" Has Gus Hopping for Awhile, But He Cures It with a Lead Pencil

By MARTIN BUNN



she can hear every word you say, so she'll have a good chance to bawl me out if I've pulled a boner. You know how it is."

Gus grinned. "No, I wouldn't know---I'm a bachelor," he said. "But I'm a pretty good guesser. Tell me what's the matter, and if the bull is on you, I'll cover you up."

The other looked reheved. "Well," he explained, "I was driving along about forty miles an hour a ways back when I beard a noise somewhere up front sounded like some one had hit the hood with a pebble. I didn't think anything much of it, but before we had gone a half mile, I saw the hand of the heat indicator jump right up into the red. Just then I saw a garage sign a little way down the road, so I drove in there.

"When I told the mechanic about the heat indicator, and about the noise I'd heard, he said

that probably my fan belt had snapped. But when he opened the bood he found that the belt was all right, although the motor was very hot. Then he said that the fan belt must be alipping, and he tightened it. He poured some water into the radiator, but it ran right out, and he said that it was coming out of the overflow pips which showed that the radiator was full, and that with the fan belt tightened the motor soon would cool off.

"I started off again, but the heat-indicator hand didn't go down to where it belonged, and before I d driven a quarter of a mile the motor was so hot that it was smoking. I stopped and waited for it to cool off. but after a half hour the heat-indicator hand still was up in the red. All the time we had been standing there the wife had been bawling me out, and I was so darned tired of listening to her that I decided I'd make it to the next garage even if I burned up the motor. Luckily it was all downhill to your place, so I shut the motor off and coasted. We've been here pretty near an hour, but she's still hot—the motor, I mean."

"I'll have a look," Gus told him. When he raised the bood and examined the radiator he whistled. "Probably bone-dry!" he said. The hose connections seemed tight. When he checked the oil he found it free from water, so the trouble couldn't be the result of a leaky water jacket. Suddenly he reached deep under the hood, lifted something out. glanced at it keenly, slipped it into his pocket, fussed around the bottom of the radiator for a few seconds, and then straightened up and winked at the worried car owner.

"I've found your trouble, Mr. Coville," he said loudly, for the benefit of the lady on the back seat. "It was quite unavoidable,

GUS SAYS:

to stick to: Put tires with the

most tread on the rear for

winter driving. Avoid, if pos-

sible, uneven wear on the two

front or two rear tires. Never

drive on any tire that you

are the least suspicious of.

Check the pressure often.

Here's a good fire policy

and the sort of accident that happens only once in a hundred years. No wonder you couldn't locate it. Fortunately there is no damage done, and I'll have you fixed up in a jiffy."

He brought a hose over to the car. "Start the engine, please," he asked. The radiator took a lot of water. "Now you'll be all right," be said when it was filled. "Leave your engine idling for a few minutes, and you'll soon see that she's normal again. If you'll step into the office. . . ."

Coville gave his wife a triumphant glance and

followed him. "What was it?" he asked when they were out of earshot of the lady in the back seat. "I saw you wink at me."

Gus laughed as he took a small pebble out of his jumper pocket. "When I found this it was the tip-off," he said. "It was a pebble that made the noise you heard, and caused all your trouble. It flew up from the pavement past your crankcase; probably hit your fan. The fan was turning pretty fast, and it threw it against the radiator drain cock, which is of the screw type, with so much force that it spun the cock wide open. Naturally, all the water ran out of your radiator in a few seconds, and your engine heated up like nobody's business."

"I'm downright relieved," Coville said, "I thought it was going to be another of those things that I never hear the end of. But say -why didn't the mechanic at the first garage I stopped in spot the trouble? He told me that the radiator was full."

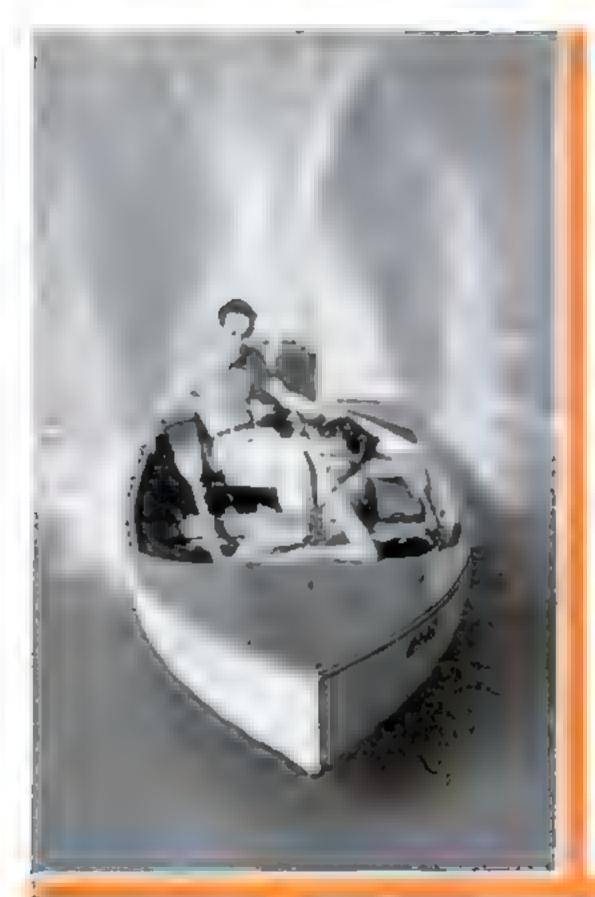
"Well, things like that are bound to happen now and then," Gus said tolerantly. "He jumped at conclusions, which always is dangerous in this business. When he put water in your radiator and it ran right out again he took it for granted that it was running out through the overflow pipe. But it really was running right through the radiator and out at the drain cock."

"Well, I'm certainly relieved," Coville said. "I'm a new customer but you can bet I'm going to be (Continued on page 244)

THE HOME WORKSHOP



TOOLS CAMERA KINKS HOME LABORATORY



Family

A FAST, SAFE

Safety at high speeds characterize this new 13½' round-bottom outboard runabout. Well adapted to both rough and smooth water, it may be used efficiently with any outboard motor of from 1 to 60 h. p.—a power range that can be achieved only with a round-bottom design.

Even if it should be recklessly driven, the boat is practically impossible to upset at any speed, excepting only in extremely high seas such as would be too much for any small boat. It is large enough to carry the whole family eafely and comfortably, easy to row, and so light that two men can lift it onto a trailer.

The design includes various features never before offered in a boat for home construction. The combination of rocker keel forward, and flat planing surface aft, and the complete elimination of tripping chines make

THIS

13½-FOOT

ROUND-BOTTOM

OUTBOARD

SEA SKIFF

RIDES VERY

SMOOTHLY

AND WILL NOT

CAPSIZE,

EVEN IN

ROUGH WATER



The boot will do better than 25 m.p.h. with a 16-h.p. outboard. Deck and seats may be arranged to suit individual preferences and size of motor

Runabout

ALL-PURPOSE BOAT

the design the safest it is possible to build. Clinker-built (lapstreak) construction with bent oak frames provides for exceptional

light weight and strength. At high speed the spray is caught by each plank lap and forced back under the boat, both increasing speed and preventing flying spray

Any one of four standard types of construction may be used. If made lapstreak, the hull will be found no more difficult to build than many V-bottom boats of the same size. The other three methods are somewhat more difficult for the amateur, but

will be described briefly.

Cost will range anywhere from \$40 to \$50 complete, depending on the materials selected. The cost may be reduced if resawed lumber is obtainable for planking. If built entirely of cedar and spruce, except for the bent ribs, the weight will be 250 lb. or less, and it

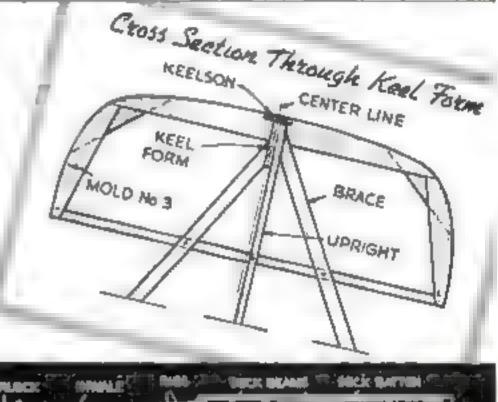
By BRUCE and WILLARD CRANDALL

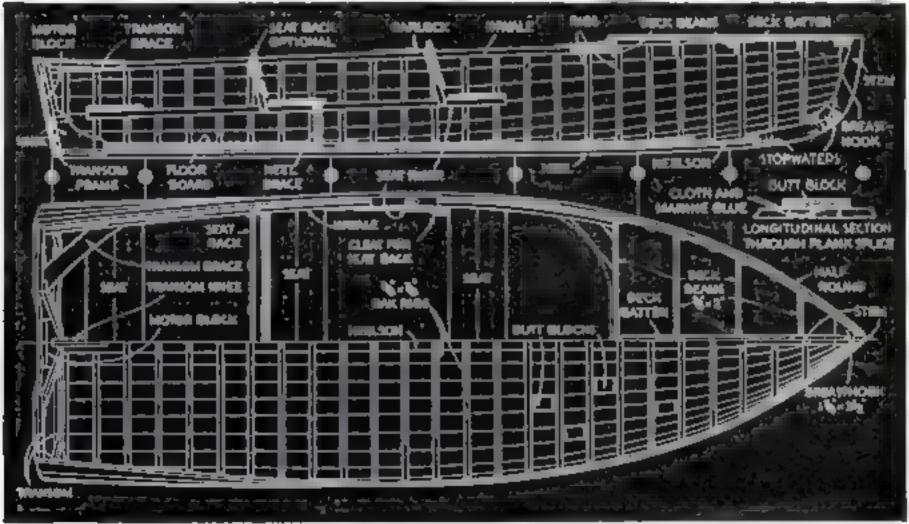
should not exceed 350 lb. with the use of any of the materials listed.

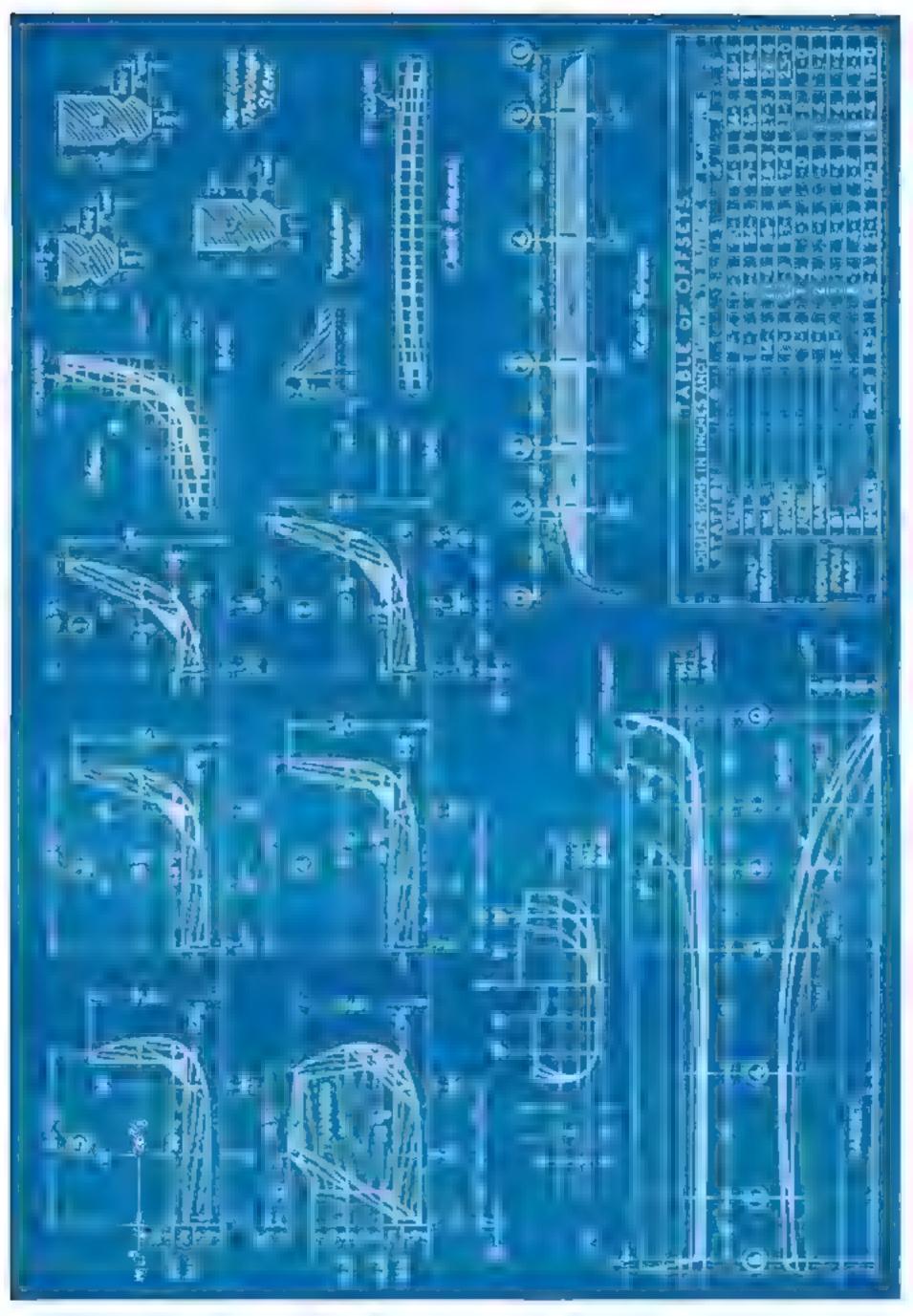
The speed obtained will, naturally, depend upon the size of motor and the load carried. With two persons aboard it will make on the average 7 m.p.h. with 2 h.p., 10 m.p.h. with 5 h.p., 15 m.p.h with 9 h.p., 25 m.p.h. with 16 h.p. and 30 to 35 m.p.h. with 22 h.p. The boat may be used safely with the

very fastest racing motors, if desired, for speeds up to 45 mph. It qualifies for racing in the outboard runabout class, but is

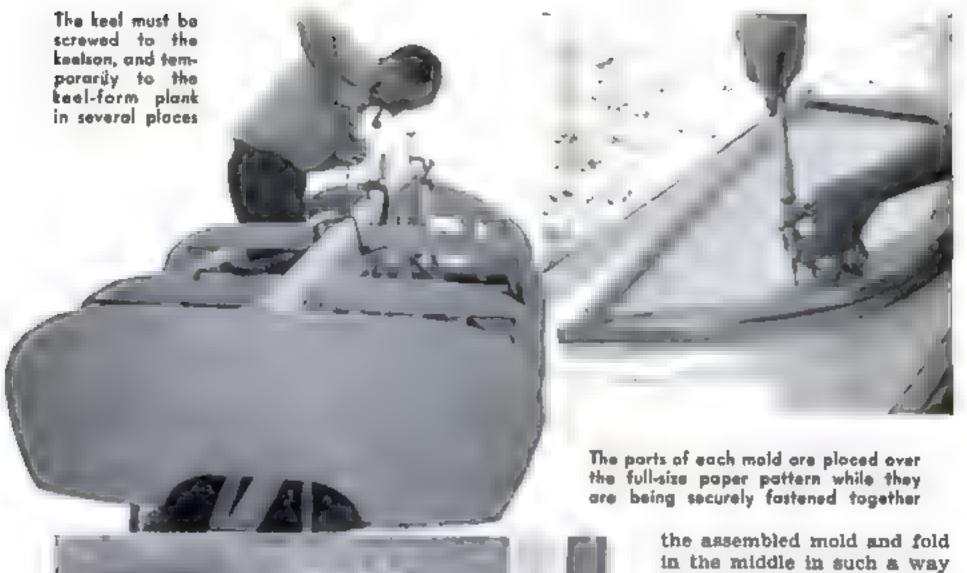
Facts About Th	e New	Outboard.	Sea Skiff
LENGTH (OVERALL)	13-5 1	DEPTH AM DE	HIPS 205
LENGTH (WATER LINE)	2 5%	COST OF MATE	R AL5 940
8EAM	56	WE GHT	275 LB
DRAFT	3	PASSENGERS	6
FREEBOARD (BOW	30	MOTORS	1 TO 60 H P
FREEBOARN (STERN)	15	SPEED	5 TO 45 M P H

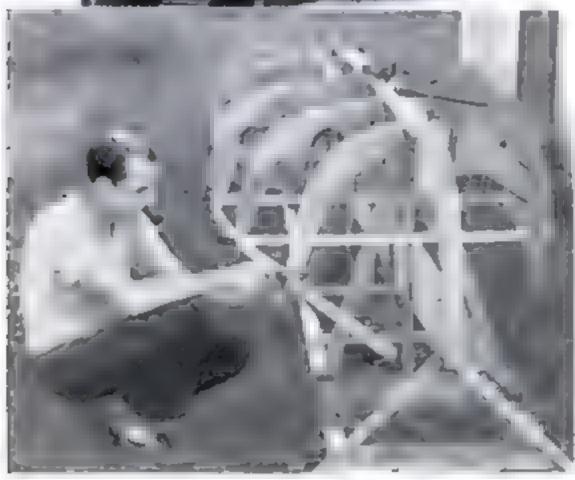






Molds, stem, and other details. A full-size layout may be made, if desired, by using the table of offsets





A light batten is bent over the molds in various places to see that there are no irregularities to cause difficulty in planking

not as fast as our racing runabout (covered in P. S. M. plans 261-262-R.)

If desired, the entire boat may be drawn full size before starting construction by using the measurements given in the table of offsets and accompanying drawings, and deducting the thickness of the planking from the full-size drawings. This is not essential, however, as this work has already been done. It is necessary only to make full-size patterns of the molds, stem, and transom, or the patterns may be purchased already drawn.

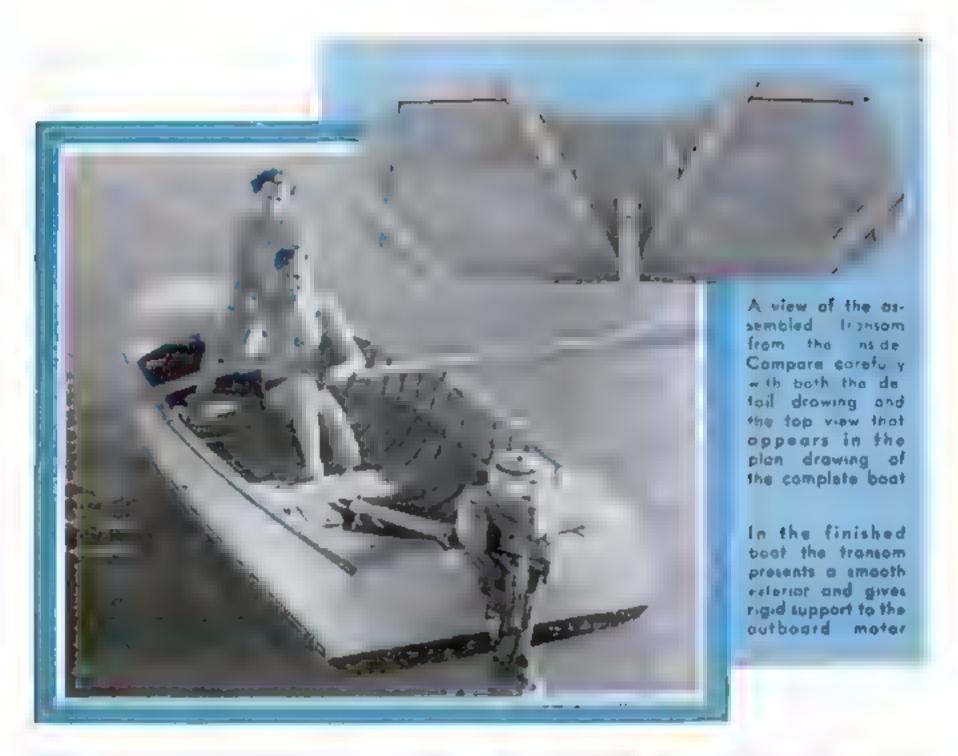
For the drawing of each pattern, use a sheet of wrapping paper large enough for

that the fold will represent the center line. Draw the base line and the three water lines at right angles to the center line and draw the two buttock lines (B1 and B2) parallel to the center line. Use the measurements from the drawings of the molds and transom. Now draw the shape of the mold by using a light batten bent into position to form a true curve, and held with small brade. Then punch through the paper at the important points, unfold it, and draw the other half

The full-size pattern is placed over the material from which the molds are to be made, and the outline of the shape transferred with a marking wheel. The pieces can then be sawn out and

planed to shape. The various parts should be in position over the patterns while they are being fastened together. The transom is laid out in the same way as the molds. The transom planking should be screwed to the transom framework and motor blocks with 14" No. 8 screws spaced about 3" apart, the surfaces to be joined first being coated with marine glue or thick paint.

Nail strips across the top of the molds and mark the center line on these strips and at the bottom of each mold. Notches for the keelson can now be cut in the exact center of each mold and in the bottom transom



frame but not the planking of the transom.

Make the stem in three pieces from 1% "
stock and check it over the full-size pattern
before fastening them together. Fasten the
two parts of the stem to the knee with two
4" carriage bolts and four 2" No. 10 screws.
Two softwood dowels are driven through for
stopwaters at the points shown in the drawings.

The boat should be built upside down on a framework supported from the floor, or from two timbers as shown in a photograph. The essential part of the framework is the keel form on which the keelson, stem, molds. transom knee, and transom will rest. Make the keel form from a 1" by 8" plank according to the measurements given in the drawing, and cut notches where the molds will rest. These notches should be deep enough so that each keelson notch will be flush with the edge of the keel form. Nail uprights to the keel form at each station and set the form up at a convenient height for working, braced as shown. The uprights must be perfectly plumb and at right angles to the keel form. The molds should be set in notches and temporarily fastened to the uprights in such a way that their center lines are perfectly plumb and at the center of the keel form. These molds serve the purpose of holding the boat in shape while it is being planked, but are discarded before the boat is finished.

The keelson, stem, transom, and transom knee may now be set up. Clamp the keel temporarily in position on the keelson in order to determine the extent of the bevel of the keelson. Taper the keelson where it joins the stem. After making sure that the transom and stem are in perfect alignment, screw the keel and keelson to the stem, transom, and transom knee with 14" and 14" No. 8 and 2" No. 10 screws. The transom knee is also screwed to the transom and fastened to transom and keel with 🔏 " by 4" bolts. The keel should be fastened to the keelson about every 6" with 14," No. 8 screws, about half of which are screwed from the inside. The joining surfaces should be coated with marine glue or thick paint before fastening. The keel will have to be fastened temporarily to the keel form in several places with about 3" roundhead screws, which will be removed and the holes plugged when the boat is taken off the keel form.

Make sure that the stem is in perfect alignment and that the molds and transom are at right angles to the keel; then brace them all in position and check with a light batten, bent over the molds in various places, to make certain there are no irregularities in the shape of the boat. The rabbet may now be cut in the stem to the thickness of the planking to be used. A light batten bent over the molds in the direction the planking is to go will give the correct angles. The transsom must also be beveled to fit the planking.

Now, if the boat is to be constructed according to the lapstreak method, it is ready for the planking, as the planks will all be fastened together at the laps and the bent ribs put in after the boat is turned right side up. Smooth-built construction methods will be discussed later.

(To BE CONTINUED)





MATERIALS FOR THE UTILITY RUNABOUT

Note: This list is based upon lapstreak construction and the seating arrangement shown in the photographs. The kinds of woods are given in the order of preference

	M	г	
	1	1 1	2 6
		_	

White coder, mehogony, red coder, cypress, white pine, fir, spruce, or redwood.

For No. Pc Planking or 12" " 6" KI4" 6"" or 15"" a a"e14" Decking Fleet boards Transom %""E 6"E14" Seats

Spruce, oak, mohogany, fir, pellow pine, cypross, codor, white pine, or redwood.

140 - 213/402154 Keel %"%3%"%12" Keelson 1500135000 41 Stem, knee, and breasthook

HARDWARE AND MISCELLANEOUS

Flathead bross, galvanized, or codmismplated screws as follows: 6 gross 1" Na. 7, 2 gross 1"4" No. 8, 6 daz. 1%" No. 8, 6 daz. 2" No. 10. Copper nails and burrs, or galvanized nails, as follows: 4 lb. 14", and 1 lb. 11/2". Also 4-5" z "4" galvanised corriage bolts; 1 qt.

K~~±3%~~±16′ Transom frame and broces | 36 " Pub" Tramom knee %***154***16* Inwales and seat roisem Molding (half-round) 1"=10"

25 %"*, %"*, 8" Ribs

Any cheop lumber

Keel form 1"±8"±12' 1"#4"#16" Molds 1"12"416" Uprights and braces "These measurements are not.

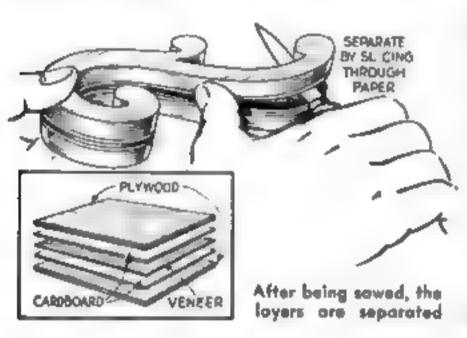
marine give (aviation or C-quality); 5 yd. catton flannelette; 3'-76" by 3/16" half-oval brass, aluminum, or galvanted trant I gal. marine point; 1 gt, spar varnish; 1 %" by 2½" shoulder screw-eye bolt; I-4" open-base cleat; I pr. oorlocks.

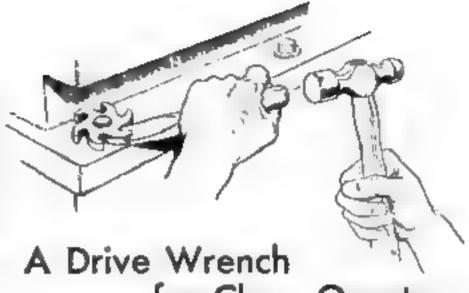
The wife true

Cutting and Shellacking Delicate Inlays

VERY small, delicate designs can be jigsawed from veneer for inlaying if a thin plywood backing is first glued to each side with pieces of heavy paper or cardboard glued between. After being sawed, the veneer can be separated by slicing gently through the paper. Several identical pieces can be cut at one time by this method.

When the wood into which the inlay is to be set in to be stained before finishing, cover the faces of the veneer with a thin coat of shellac before gluing the "sandwich" together and shellac the edges after the pieces are cut.—J. BRUMFIELD.





for Close Quarters

THERE are countless different types of wrenches on the market, yet a new style or idea develops every now and then. Recently the writer made up a set of six standard-size wrenches of the type shown, as well as a notched drift to drive them. These wrenches can be used where a nut is hard to get at and are particularly useful for starting stubborn nuts.—Charles Willey.

\$100 in Prizes for Letters

Your chance is as good as the next reader's to win a prize in our new contest. See "Our Readers Say" Department in this issue for full particulars.

Rope-of-India Smoking Stand Provokes Curiosity

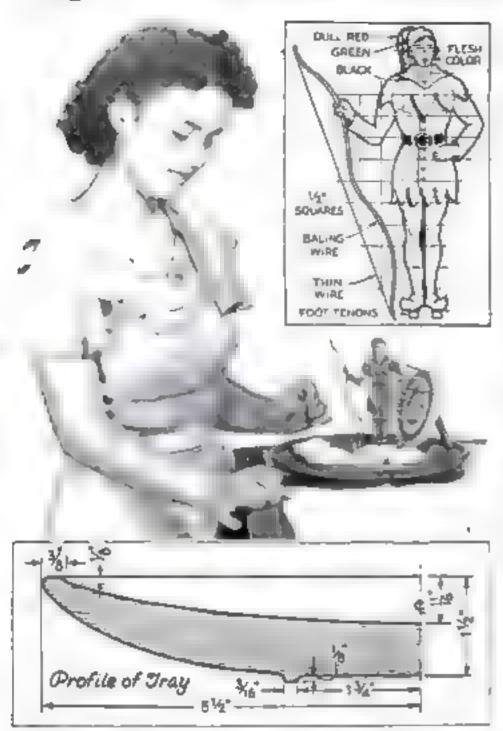
REMINISCENT of I smoking stand appear of rope. The base is 1" oak, 15" long, fa The tray support is a struction, but only 8 on both ends so it cotting hole in both the The tray or top is %," read with %," rope, to A length of %," read with %," rope, the rope with the of this end firmly in of this end firmly in of the rope with the the rope

REMINISCENT of India's famous rope trick, this smoking stand appears to be supported by a piece of rope. The base is made of two pieces of \(\frac{1}{2} \)" by 1" oak, 15" long, fastened with a cross-lap joint. The tray support is of the same material and construction, but only 8" long. A \(\frac{1}{2} \)" rod is threaded on both ends so it can be screwed into a tight-fitting hole in both the base and the tray support. The tray or top is \(\frac{1}{2} \)" plywood, the edges being covered with \(\frac{1}{2} \)" rope, tacked on with small wire brads.

A length of %" rope is now placed on the rod. First whip or bind one end with cord; then grasp this end firmly in one hand, and about a foot up the rope with the other hand; next twist against

This will cause the strands to separate, and the rope may then be slipped over the rod. At the top of the rod, the rope is again whipped. Stain the wood, and varnish. Shellac all rope. A cigarette humidor to match is made by colling and stitching %" rope tightly about an empty tin can.—RALPH E. DASCHKE.

Jig-Sawed Archer Guards Unique Canapé Tray



Cross section of tray, which is turned on a lathe, and, above, completed novelty and diagram of orcher

AN ARCHER in Lincoln green stands proudly beside his target on this novel canapé tray. The picks are his arrows, grouped around the golden bullseye.

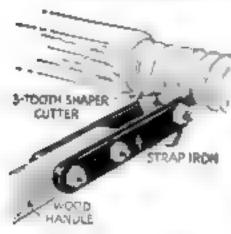
Any well-figured hardwood is suitable for the tray. Red gum, which requires no filler, is handsome when finished with clear varnish or lacquer, and was used for the tray illustrated. Turn the bottom of the tray at moderate speed. It is then necessary to remove the work from the lathe and reverse it. To make centering easy, turn a 14" plywood disk to fit the bottom recess, loosen the screws, and force the disk into the cavity. Tighten the screws and shape the tray top. Smooth it down with sandpaper,

Draw a pattern for the archer, transfer it to hardwood plywood, and jigsaw to shape. Paint him light green, with the cap feather dull red and the details in black. The bow is bailing wire, bent to shape, passed through a hole in the man's hand, and strung with thin wire

wire.

The target and legs are cut in one piece. Punch the pick hoise at random with an awi. Make the back prop so that the target leans back about 20 deg. from the vertical. Paint the bullseye gold; the rings (from center outward) red, light blue, black, and white; and the feet and prop, green.—E. M. L.

Shaper Cutters Utilized as Wood-Turning Tools



Method of mounting a cutter of the proper shape to turn beads on a wooden spindle

WHEN a few beads or other duplicate contours are required in turning wooden furniture spindles, time can be saved by utilizing a standard three-toothed shaper cutter. Mount the cutter at the end of a wooden handle by means of two pieces of strap iron and three bolts, as illustrated.—C B.

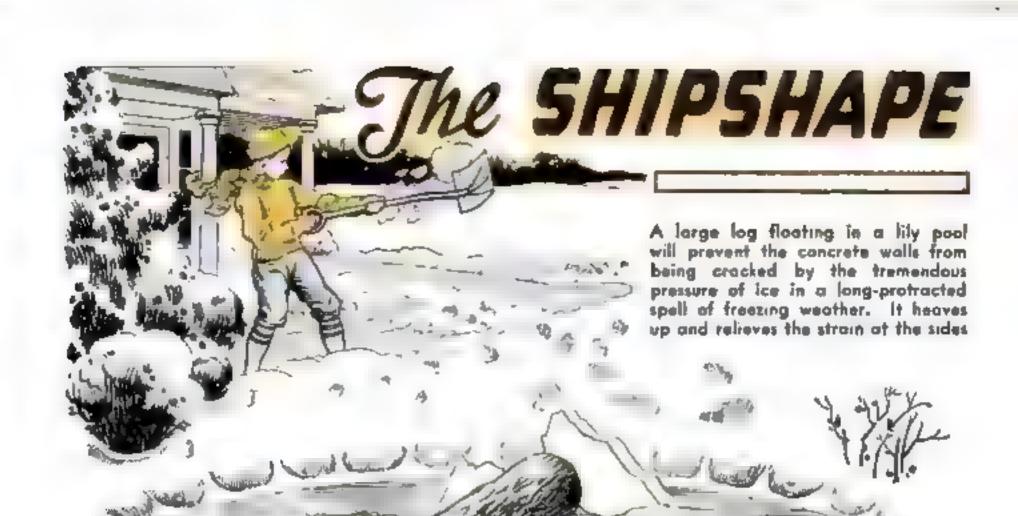
Cork Used as a Shaker Top

A SHAKER top for a bottle can be made by using a cork with a small hole burned through it with a hot nail. When not in use, plug the hole with a match stick.



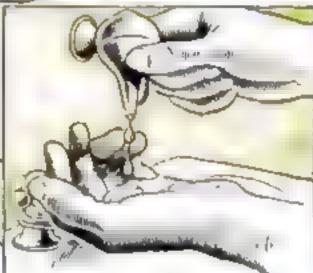
Graphite Lubricates Tip of Soldering Iron

AFTER an electric soldering iron has been in use for some time, the tip becomes corroded. To prevent this, dust ordinary graphite or plumbago in finely powdered form over the threads inside the copper tip each time the latter is changed.—O. B.





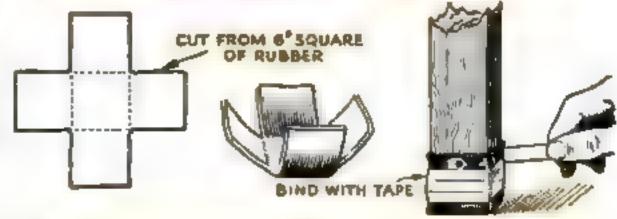




RUBBER CRUTCH TIP PADS END OF BROOM HANDLE

A rubber crutch tip on the end of a broom or dry-mop handle gives a better grip and protects the walls and furniture Liquid soop can be dispensed by using a small ear syringe. A rubber suction cup is fastened firmly to the syringe with rubber cement so it can be attached to the wall above the wash basin

traning-board legs often mar a linaleum or hardwood floor. This can be avoided by padding them with pieces of heavy sheet rubber

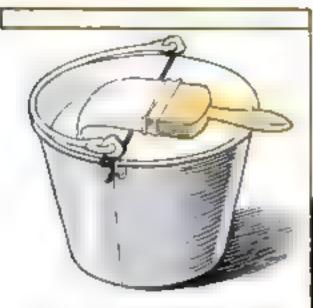


Either a rubber stair tread or a piece cut from an old inner tube may be used for the pads. They are tacked and taped on the legs

SANDPAPER GIVES GRIP ON TIGHT JAR CAPS

In the obsence of a suitable jar-lid remover, stubborn jar caps can be turned by using a piece of sandpaper to give a grip on the smooth metal.

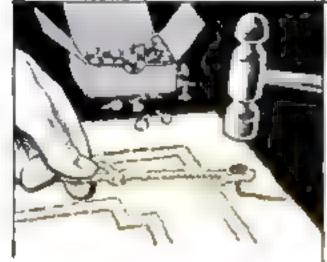
HOME



A stout cord tied to the handle lugs of a wall-paper poste poil serves as a handy rest for the brush when not in use. Excess paste may be removed from the brush by wiping it off against the cord with a little pressure

With a sprinkler made as shown below, it is easy to moisten clathes evenly and quickly for ironing. It consists of a bulb taken from a battery filler and an ordinary sprinkling head sold at most hardware and ten-cent stores



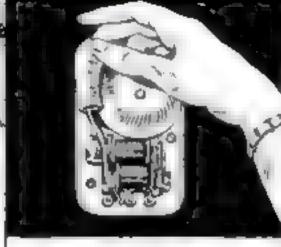


BENT PIPE CLEANER HOLDS CARPET TACKS IN PLACE

Short corpet tacks are easily started with the aid of a pipe cleaner. Slip out the cleaner after the tack is partly driven

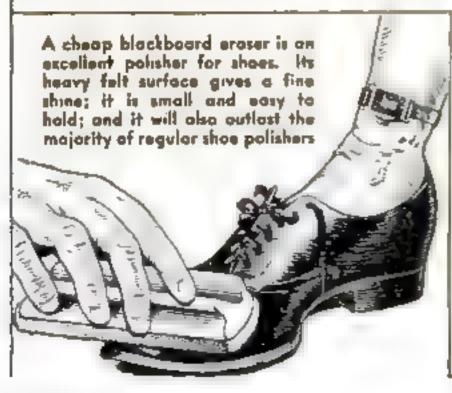


Small children may be kept from opening a cutlery drawer in a kitchen or breakfast-set table by fastening a small butt hinge upside down on the underside of the table tap in front of the drawer. To open, push up the hanging hinge leaf



OLD GLOVE FINGER QUIETS DOORBELL

A finger out from an old glove will silence a doorbell when some one is ill or when the baby is asleep

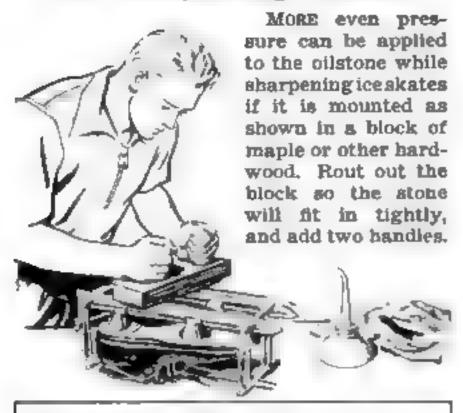




KEEPING CLOTHES HANGERS ON A LINE

If two clothes hangers are used instead of one, a dress, coat, or sweater will not blow off the line when put out for an airing on a windy day.

Oilstone Set in a Block for Sharpening Skates



The black should be about I" langer and wider than the stone. It is routed out 1/2" deep to fit

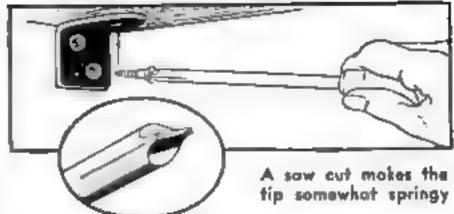
ROUTED & DEEP

A TIGHT FIT FOR

OILSTONE

HARDWOOD

I'M"THICK -+



Screws Held on Driver by Slotted Tip

A screw driver for holding acrews to be driven in tight corners can be made from a piece of 1/4" or 3/16" drill rod. This is slotted down the center with a thin back-saw blade deep enough to make the top edges slightly flexible. The tip is then filed or ground concave as shown. When it is inserted in the alot of a screw head, the pressure is sufficient to hold the screw securely while being driven in place.-E. WONDRACEK.

Keeping Down Dust in the Shop

SHOP floors can be quickly dampened before sweeping with a twenty-five cent spray gun of the continuous-spray type.—E. R. O.

Alarm Clock Closes Bedroom Window in the Morning

LTHOUGH many methods of using an alarm clock to close a bedroom window in the early morning have been devised, one of the simplest is that illustrated. The window is adjusted to slide easily, and, if necessary, hot paratim is applied to the runs. The weight is a piece of from pipe with its lower end closed by a cap and its upper end by a wooden plug. Lead shot is poured into the pipe until it closes the window gently. To hold the window up, an ordinary bolt is used as indicated. Beneath this an inexpensive alarm clock (with bell removed) is mounted on two acrews by means of

slotted holes in an L-shaped bracket soldered to the case. The bent end of

the wire engages a hale in the bolt

It can then be readily removed for winding. A. piece of stiff wire is soldered to the alarmwinding key of the clock and bent so as to engage the hole in the bolt from which the knob has been removed. When the alarm goes off, the key turns the wire and slides the bolt back so that the window will immediately close automatically.-BERTRAM BROWNOLD.

The plarm clock

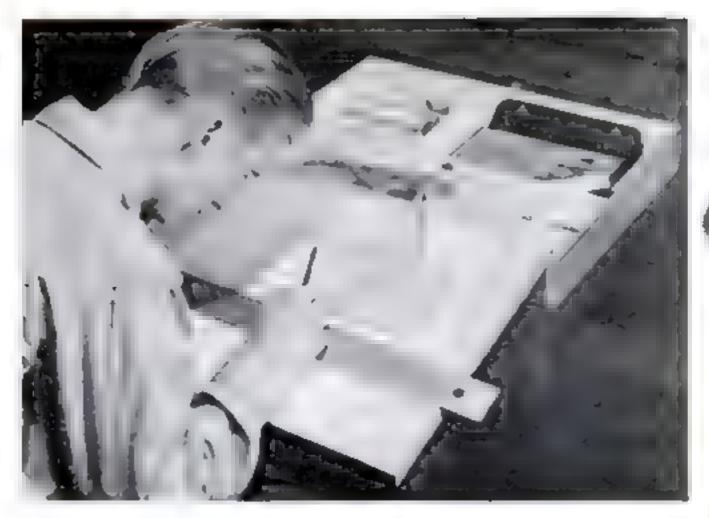
moves the bolt.

and the weight

hooked on the

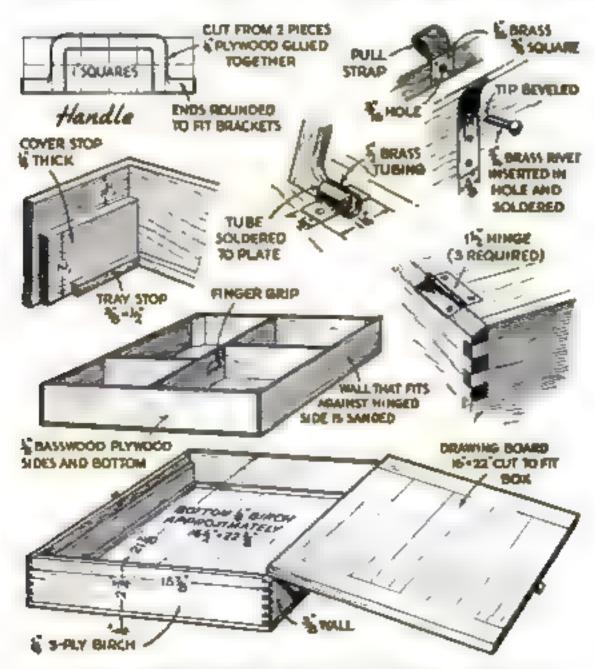
lower sash gulls

down the window



When the box is open, the board rests at a convenient angle for drawing. Everything can be corried except the T-square and ink

Complete Drafting Kit



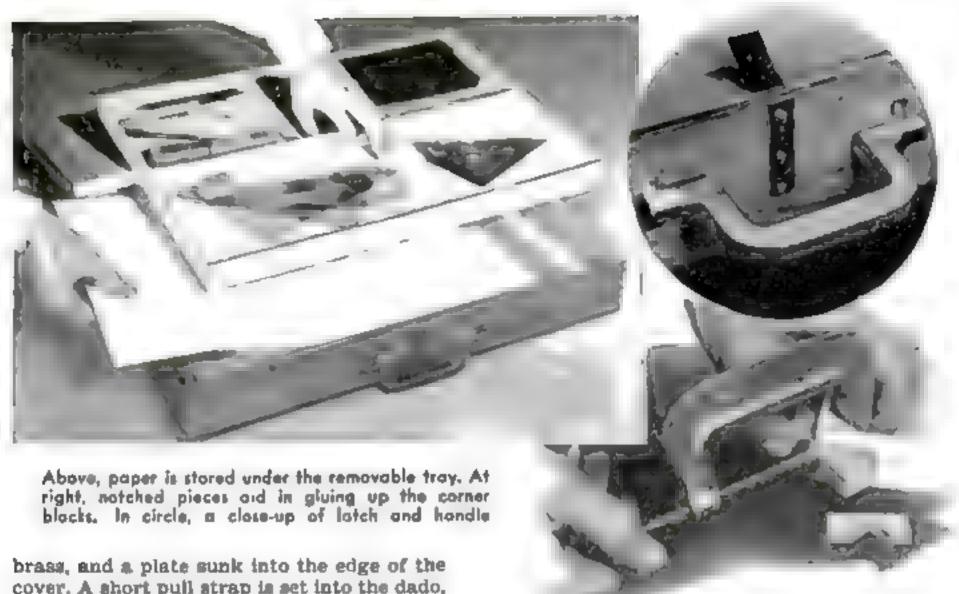
Drawings for making the kit. Note how the three hinges are fastened and that the back edge of the box is beveled for the board

By HENRY and RICHARD HANSCOM

CRAFTSMEN who make occasional drawings, as well as architects, engineers, and draftsmen, will appreciate the many features contained in this drawing box. A removable tray affords ample room for drawing instruments, and a compartment beneath keeps a supply of paper clean and flat. When opened, the board rests at a convenient angle for drawing.

The tray should be slightly smaller than the inside of the box, and because of the thin wood it is advisable to use glue alone for fastening the walls and partitions. The latch is simply a brass rivet soldered to a strip of spring

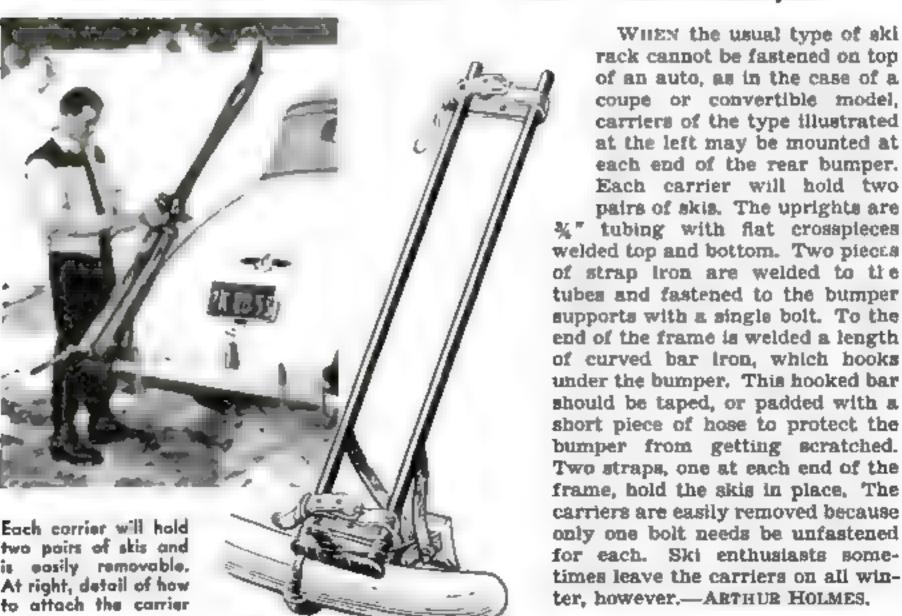
विवर्षकृत्यसम्बद्धाः विवरणपुरः स्टब्स्य स्थल



brass, and a plate sunk into the edge of the cover. A short pull strap is set into the dado, the undrilled plate is acrewed in place, the cover closed, and a 3/16" hole drilled through the case wall into the plate. The hole in the case is then reamed slightly, and the spring brass plate is screwed into place. Two coats of shellac over the entire exterior, followed

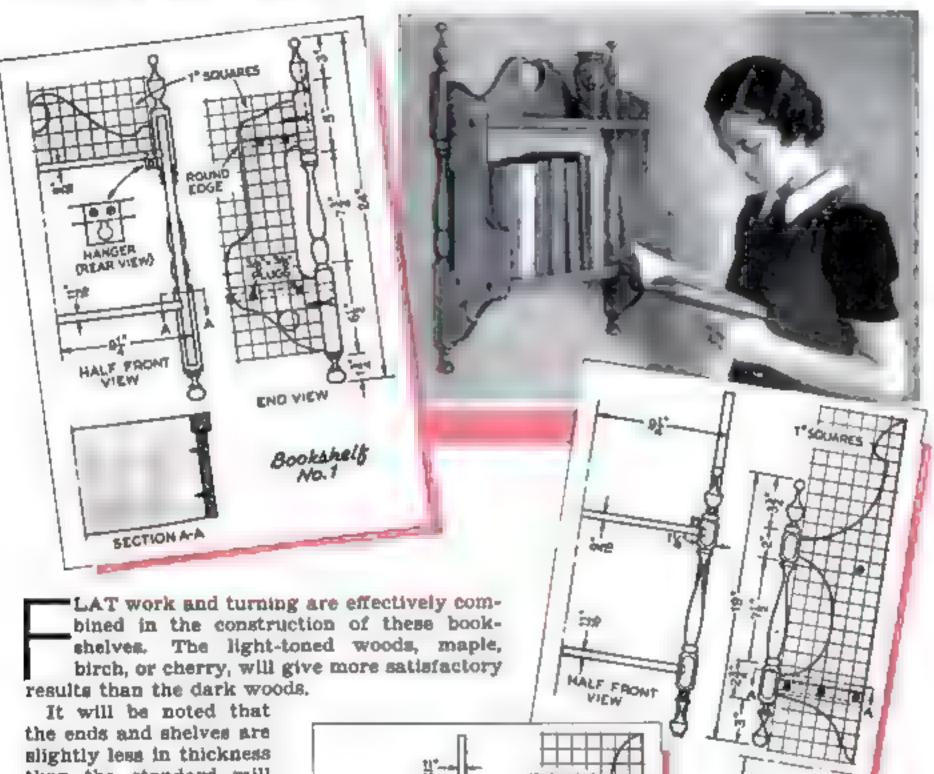
by a ructing with steel wool, will give a satin finish. No accommodations have been made for ink because of the possibility of its spilling when the case is carried.

Ski Carriers Fastened to Rear Auto Bumper



Three Hanging Bookshelves

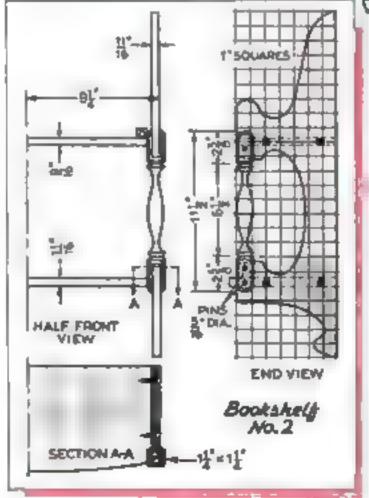
ORNAMENTED WITH WOOD TURNINGS



It will be noted that the ends and shelves are slightly less in thickness than the standard mill sizes. The end pieces are dadoed 3/32" deep to receive the ends of the shelves. The screws to hold these parts together are sunk about 4" deep into 4" holes. Each hole is squared with a 4" chisel to receive a square plug, which is slightly tapered and glued before being driven into place. Leave the plugs long enough so they can be

Fasteners for hanging the shelves are cut and drilled from a 16-gauge (1/16") sheet steel.

shaved off flush after-



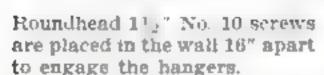
The shelves are assembled with screws, and the heads hidden with square plugs

Bookshelt Mas

By ROGER MOYER

wards.

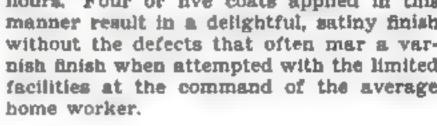
Adding the decorative turnings to two of the bookshelves. In one design left they are held with wooden pins; in the other, below, they are fastened with bind dowels. All parts are maple



If a tone darker than the natural color of the wood is desired, it can be obtained by staining with a solution of bichromate of potash in the proportions of an ounce to a pint of water. This should be tried on a piece of scrap material.

An oil finish was given these pieces. A half-and-half mixture of turpentine and boiled linseed oil was applied with a cloth and rubbed down after twenty-four hours. This was followed with a light coating of linseed oil only, rubbed again after twenty-four

hours. Four or five coats applied in this manner result in a delightful, satiny finish without the defects that often mar a varnish finish when attempted with the limited facilities at the command of the average

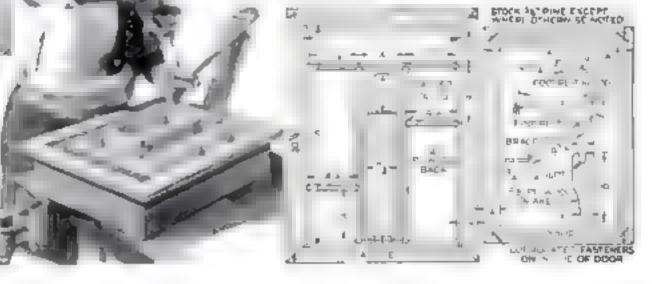


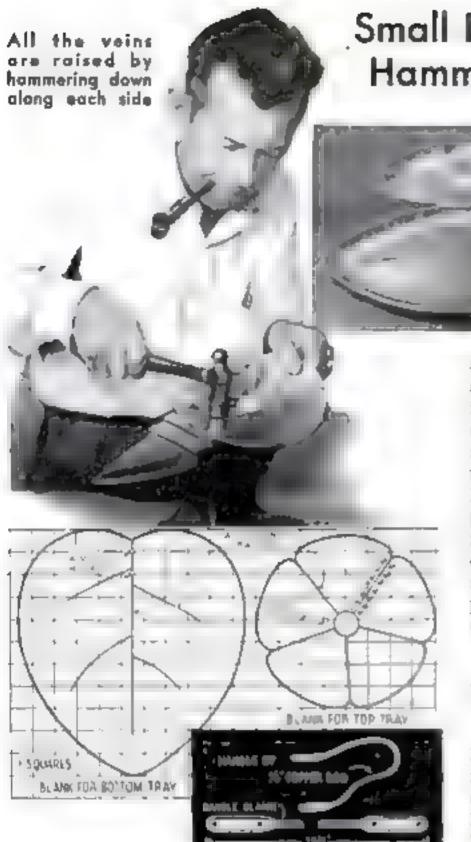
Shoe-Polishing Cabinet Built into Wall to Save Space

This built-in cabinet holds shoe polish, liquids, and brushes and has a folding footrest of convenient height. The cabinet is designed to fit between ordinary studding, 16" from center to center. The bottom of the opening in the wail should

> be about 10" from the floor. The supports for the foot-rest holder are nailed, with their straight edges facing out, to the two center partitions. The brace is hinged to the cabinet and footrest with 2" butt hinges. The door frame is grooved for a *4" plywood panel and has mitered joints held with corrugated fasteners. Hinge the door with butterfly hinges.

The cabinet is assembled as a unit, foot rest and all, and then placed in an opening cut in the wall. It is nailed to the studding from inside. Point it to motch the wood frim





Small Leaf-and-Blossom Tray
Hammered from Aluminum

ALUMINUM responds readily to the craftsman's hammer, and anyone will be surprised at how little time and effort are required to make this useful and decorative double-deck leaf-and-blossom tray.

The two trays are cut from 16-gauge soft

sheet aluminum, and the hammering and shaping are done with the polished planishing end of a ball-peen hammer. Sketch pencil lines in to represent the veins. These should then be slightly raised by driving the metal down on each side of the lines, as illustrated. The handle is of '\(\frac{1}{2}\)" polished copper rod. It is riveted on with aluminum rivets, which should be hammered down evenly so that they will not show in the inside of the finished trays. The trays are polished with fine abrasives, but not lacquered.—Dick HUTCHINSON.

Reading Star Charts at Night

IN TEACHING stars to nature groups, we had difficulty in using the star charts at night. A flash light was unhandy, so we cast about for another solution and finally hit upon luminous paint. The star dots and letters were traced with the paint.—L. B.

INSIDE FINISH FOR DRESSER DRAWERS

[PAINTING]

- 1. Sand drawer sides, ends, inside bottom, and back faces glass smooth with No. 4/0 garnet paper. Dust out carefully.
- 2. Mix 1 part orange with 3 parts white shellac and reduce with 4 parts denatured alcohol. Pour this into an equal volume of shellac-mixing lacquer, if available. Do not make up more than needed.
- 3. Apply a thin, even coat with a minimum amount of brushing. Let dry hard and sand with No. 6 0 garnet finishing paper moistened on the paper back.
- 4. Apply a second coat. Dry hard Resand glass smooth. Test the corners, edges, and faces with the fingers. Dust out.
- 5. Wring out a cotton-flannel cloth in water; apply a few drops of white mineral oil; rewring the cloth several times, and then use to wipe clean all finished surfaces.

FOPULAR SCIENCE MONTHLY SHOP DATA FILE

SHEPHERDS

HOW TO MAKE SWEET-TONED MUSICAL INSTRUMENTS AT



PAGE TO TO BE THE PROPERTY OF DESCRIPTION AND PROPERTY OF

Quartet of bamboo pipes. Left to right, troble pipe in the key of D, olto in A, tenor in D, and bass in G

ROBABLY the easiest and cheapest of all musical instruments to make is a bamboo shepherd's pipe. It has a soft, sweet, flutelike tone that is pleasing in solos and especially delightful in trios or quartets.

The making and playing of shepherds' pipes is a hobby of growing popularity, not only among school children and Girl Scouts, but also among adults. In England there is an active organization known as the Pipers' Guild, and the American National Branch of the Pipers' Guild was recently organized in the United States under the direction of

Top and side views of a trable pipe, showing the spacing of the holes, and a chart of the fingering

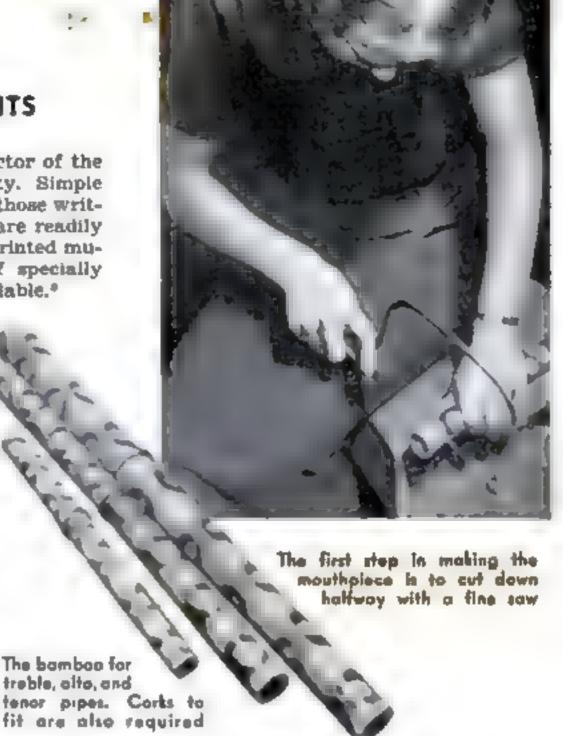
PIPES

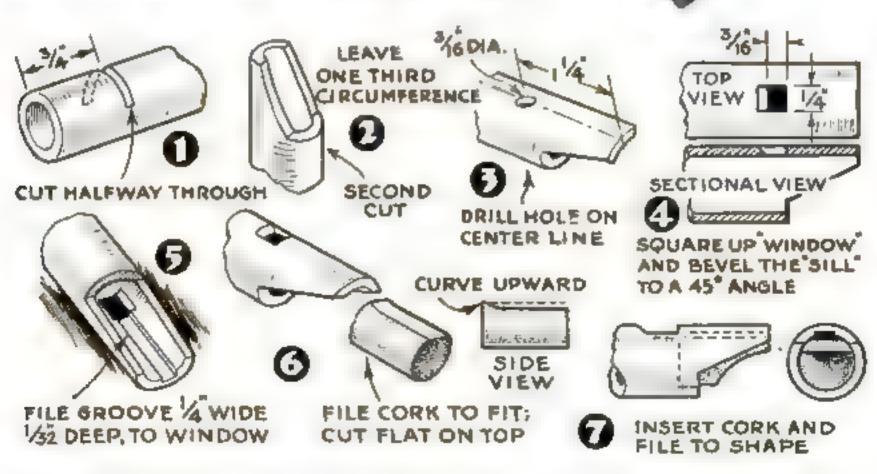
A COST OF A FEW CENTS

Miss Jennie Cossitt, musical director of the Union Settlement, New York City. Simple songs and folk dances, especially those written in the keys of G, D, and A, are readily played on the pipes either from printed music or by ear, and a variety of specially arranged music for pipes is available.*

Although pipes are made in various sizes, the first one to construct is that known as the treble pipe. This requires a piece of bamboo from %" to %" in inside diameter and about 11%" long. Unless a long enough piece of bamboo can be obtained without a joint, it will be necessary to file, bore, or burn out the partition at the joint or joints. In other words, there must be a smooth, uniform hole all the way through.

The mouthpiece can be at either end, but should be at essential the should





Obtaining a good tone depends to a large extent upon the way the mouthpiece is made. The bevelod edge of the window must be very sharp. If the tone is faint, file the cork to increase the air passage

least 2" from the nearest joint. Locate it so that the groove in the bamboo, if there is one, will be along the left or the right side rather than on top where it would interfere later with closing the holes. Cut the mouthpiece as shown with a back saw or other fine-toothed saw.

In the center of the top, 1%" from the mouthpiece end, drill a 3/16" hole. Then enlarge it with the point of a sharp penknife to a rectangle exactly 3/16" by ¼", as indicated. Next, bevel what is called the "window sill" to a 45-deg, angle. See that the lower edge is sharp and smooth.

From the end of the mouthpiece to the window, file a shallow groove in the underside of the top to form the roof of the wind passage. This groove must be perfectly flat and square cut, but not more than 1/32" deep. Later on it can be deepened slightly if the tone does not come freely enough.

A smooth, firm cork is now fitted into the mouthpiece to

reach up to the edge of the window. When it fits perfectly and rather tightly, a thin, narrow shaving is cut off it with a very



The scale must be tuned accurately by ear or with a plana

sharp knife, as shown. This forms the floor of the wind passage. Note that it is slightly curved so as to deflect the breath upward. The shape and size of this cut and the sharpness of the edge of the cork are most important, but if a cork is spoiled or does not give the desired results, a new one is easily made. File the cork so that it fits comfortably in the mouth.

You should now be able to get two clear, pleasant notes by blowing gently into the pipe, one being about an octave higher than the other. Concentrate on the low note until you get a tone of satisfactory quality. Then, if you wish to play with other instrumenta, compare it with D on the piano—

the D which is eight notes above middie C. If the pipe seems to be a half note too low, saw off about 1/2" from the lower end; if it is a whole note low, saw off about 1". Work slowly and saw off a little at a time until the D has been accurately tuned.

Measure the distance from the center of the window to the end of the pipe and drill a \%" hole at exactly a quarter of this distance from the lower end This hole should give the second tone of the scale, or E, but it will probably be too flat, so enlarge it by small degrees with a reamer or sharp knife until it is in tune with E. Be careful not to split the bamboo.



The second hole is placed about %" above the first one unless the first hole had to be made larger than 3/16", in which case it is better to space it 1" away. It should be tuned to F sharp. The third hole, placed about %" away, is tuned to G.

By closing these three holes with the first, second, and third fingers of the right hand, you will be able to sound the original D. Then, by raising the fingers one after the other, the notes of the scale will sound up to G.

Place the remaining three holes approximately as shown, and tune them to A, B, and C sharp. The latter is usually placed 24" from the window. The final hole, which gives D an octave above the first tone, is drilled on the other side or bottom of the pipe a triffe above the position of the sixth hole, and it is closed with the left-hand thumb.

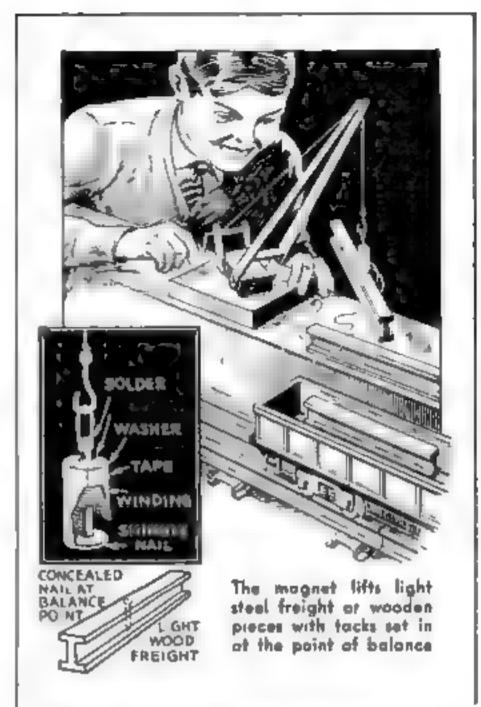
If any holes are enlarged too much by mistake, they can be reduced in size with plastic composition wood, which may also be used for filling any cracks.

Three smail additional tuning holes can be drilled where indicated, if desired, for raising the pitch of the entire scale, and these are plugged with small tuning pegs. A rubber band stretched over the top part of the window will lower the pitch a triffe.

Half tones are obtained either by uncovering about half the hole instead of all of it, or by closing one or two holes immediately below the open one which gives the note it is desired to flatten. Each pipe has an individuality of its own, so the fingering for the half steps in the scale has to be worked out by

experimenting

The alto pipe is tuned to A and requires a piece of bamboo at least %" in inside diameter and 184" long. The window is cut ¼" by 5/16". The tenor pipe is tuned to D an octave below the treble pipe. It requires a piece of bamboo about 14" in inside diameter and 24" long, and the window is cut %" by 5/16". In this case, the first hole is placed almost ¼ " farther up the pipe than the quarter mark. Bass pipes are made both from bamboo and aluminum tubing, and are tuned to the key of G. They require a piece of 1%" or 1%" in inside diameter and 36" long. The window is placed 1%" from the mouthpiece end and is %" by %". The first hole in this case is one third instead of one fourth the distance from the middle of the window to the end; and the sixth hole should be about 10 % " from the middle of the window.

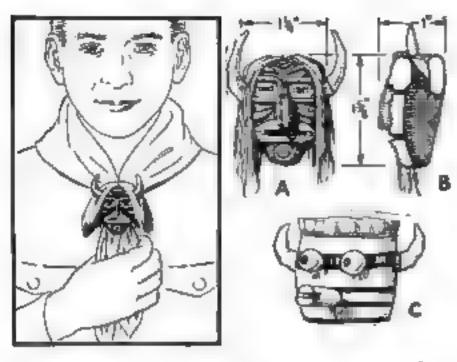


Miniature Electromagnet Loads Model Train

A SMALL electromagnet for loading freight on a model train may be made from materials which hearly every experimenter has lying around.

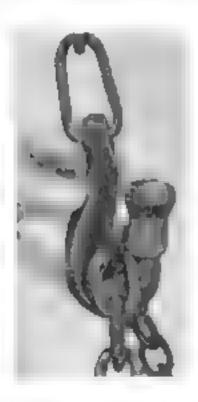
The core is a shingle nail with the point cut off. A small washer, made from a disk of sheet metal the same size as the nailhead, is soldered on the nail 1" from the head. A loop of wire is also soldered to the end of the nail for attaching the magnet to the cable of a crane. Fill the part between the washer and the head by winding on even layers of any available small magnet wire, such as No. 34 enameled. Leave the ends of the wire long and cover the coil itself with a layer of cellulose tape.

One dry cell, which may be concealed under the freight platform, will operate the magnet. If suitable lightweight "freight" made of steel is not available, imitations can be made of balsa wood or pine and painted, but drive in a tack or small nail at the balancing point so that each piece can be picked up by the magnet.—FRED KUHLMANN, JR.



Indian Finger Masks Made into Neckerchief Slides

Boy Scotts who wish to make something unusual in the form of neckerchief slides can do so by whittling them in the form of Indian finger masks from soft wood. These were symbols of secret societies or professions and were worn on the fingers during ceremonial dances. The design shown at A and B is a Sioux mask with the skin colored red and the lips, eyes, and hair white. At C is a Zufil mask with white skin and black trimming. The squares in the eye band are painted red, green, and yellow. The head-dress is tinted light yellow or blue. Dog hair or frayed cord will serve as hair, if it is needed.—George C. Sponsler.



Chair Tip Acts as Hook Latch

ON SMALL chain hooks, which have no latch to keep the links from dropping out, a common crutch or chair tip will serve to keep them in place securely, as illustrated at the left. The tips may be obtained in several sizes to fit different books.

Removing Colored Printing

To REMOVE colored printing and designs from celluloid or plastic objects, such as advertising novelties, rub them with a cloth moistened with acetone or nail-polish remover, which is obtainable at drug stores. Then clean the surface with another cloth and a little alcohol.—M. H. KINDERMANN.

Pencil Holds Materials for Emergency Mending

A NEEDLE and several lengths of thread in popular shades can be kept in a mechanical pencil of the type shown at right for emergency mending when away from home facilities. The threads are braided together and folded as compactly as possible. Easily carried in a pocketbook or clipped to a pocket, one may write or mend as required.



A needle and several lengths of thread are carried in the pencil



Electric Iron Kept Handy in Extra Deep Closet

WHEN space permits, it is best to make an ironing-board closet slightly deeper than usual, as illustrated. The iron can then be left on its shelf at all times and does not have to be put away separately. Sheet asbestos should be tacked to the closet walls around the iron shelf to protect them from being scorched. A band of the same material is wrapped around the ironing board near the hinged end to safeguard it when the closet is closed.—J. MODROCH.

A tank should be filled with developer as quickly as possible. To help in doing this, sand the outside of a small plastic funnel to fit the opening tightly

Tricks IN USING ROLL-FILM Tanks



When cut firms are developed in a roll-film tank, line up six on each side, their ends side by side. This will prevent developing marks made by the end of one touching another

After washing film, place one drop of potassium-permanganate solution inside the core then let wash water flow through a owly. A purple color shows that all hypo has been removed



For odd sizes or if the adjustment has become worn, wind a clean rubber band tightly around the care to hold the parts



If a rail refuses to feed into the reel without sticking, try starting it at the care. Squeeze the edges bow-shaped so they will fall into and forlow the groaves



Above, finger-nail clippers are used to round the corners of a film so it will slide in easily. Left, a comb with every other tooth removed is used with a wad of cotton to dry real grooves



ann Smith Living From channe Heaten a-221

Ann Smith Living From channe Heaten

10/16/39 B 50 Light Holls & 16 1/2 dec 7/002

10/16/39 D

When this partrait of Ann Smith was taken, the data relating to the film, stop, speed, and lights were entered in the proper spaces on the 3" by 5" card. Later, the printing and enlarging data were added, and a print was stuck on the back for reference

HE problem of recording exposure data systematically has troubled the amateur photographer for years. Memory cannot be trusted, and data scribbled on scraps of paper are often lost before being permanently written in a log book. The logs themselves are often inadequate and seldom contain sufficient space for all the information that should be preserved.

To solve these difficulties, the accompanying data card was especially prepared for POPULAR SCIENCE MONTHLY read-

ers. It is based upon a suggestion made by Theodore Blank, an amateur photographer of Dorchester, Mass. If printed on 3" by 5" cards, these forms are easily filed and an adequate supply of blank cards can always be carried in the pocket. Any amateur may have a local printer copy the set-up and print a supply for his own use, or they can be reproduced by the inexpensive photo-offset process. It should be noted, however, that the cards are copyrighted and are not to be sold commercially.

In using the cards, the best procedure is to jot down all the exposure data at the time the picture is taken and then fill in the rest of the card later when darkroom tests reveal which grades of contact and enlarging paper give the best

results. Details regarding masking, dodging, and other manipulations can be noted under "Remarks." Mount a contact print on the back of the card and, if necessary, rule it to show which portion makes a wellcomposed picture. Place each negative in a separate envelope, give it a number, and file numerically: write the same number under "Neg. File No." on the data card.

A concrete example of the use of the cards is given in the accompanying photographs. The portrait of the young woman was taken in a light-walled living room. In addition to the two lights shown, there were two lights at the left side of the sitter. The

position of all four was indicated in a diagram, and notes were added to show that the film was Verichrome, the stop f/16, and the speed 1 1/4 sec.

Later, when the prints were made, the grade of contact paper. No. 2, and the exposure time, 5 sec., were entered. After the final enlargement had been made, the grade of enlargement paper. which was normal, and the exposure, 16 sec., were marked down. A contact print was then mounted on the back of the card. and lines were ruled on it to show the best composition or "cropping."

When a satisfactory enlargement had been made, lines were drawn on the reference print to show the best composition or "cropping"

1194 OF DAY

EXPOSURE

susject

0415

GRADE OF CONTACT PAPER

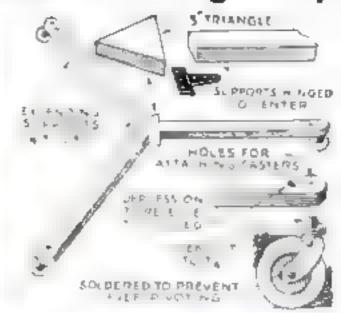
Many a photographer will not use all the divisions, but they are there in case he wants them at any time. No elaborate description is required under "Subject" because the print is on the other side, available for immediate inspection. The cards may be filed alphabetically according to subject or by any other convenient method.

The cards are especially helpful to the beginner because they afford an opportunity for him to compare his shots and discover how to obtain the best results. The mere fact that he has to fill out the card each time will also make him conscious of factors he might normally forget.



Movie Camera Wheeled About on a Folding Dolly





be obtained by the amateur movie cameraman if he has a homemade camera dolly or portable stand. He can then change from a general scene to a close-up without a break, or follow a moving person or object. The

dolly illustrated may be folded for convenient carrying. The rolling casters should have a wheel of about 2" in diameter, with the pivoting base soldered in place to prevent free turning. The surface upon which the dolly is rolled should be smooth, but small irregularities in the floor may be overcome to a certain extent by cementing ¼" thick strips of sponge rubber to the caster wheels.—M. G. WINTERTON.

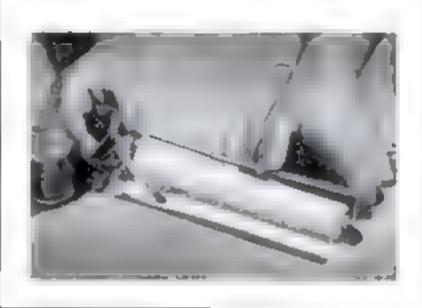


How to Focus Sharply When Light Is Dim

In Poorly lighted interiors it is hard to get a sharp image on the ground glass. This can be made easier by attaching a small square of transparent cellulose tape to the middle of the glass, on the ground side. The glass becomes transparent at this point, and the clear image thus provided may be used in checking the focus.—K. L. R.

Ferrotype Roller Covered with Blotting Paper

When only a few glossy prints are made at a time, cover the print roller with one or two thicknesses of blotting paper. It will then press the photographs into good contact with the ferrotype tin and remove excess water.

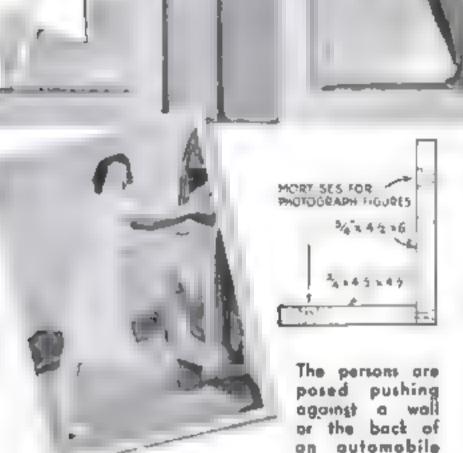


Photographic Cut-Outs Appear to Prop Up Book Ends

To MAKE novel photographic book ends of the type illustrated, first take pictures of the subjects pushing against a wall or the side of a car and enlarge to 5" by 7". These enlargements are mounted on ¼" thick plywood with glue or dry mounting tissue.

The outlines are then cut on a jig saw with a rather fine biade. Small extensions or tenons are left

on the hands and feet for attaching the figures to the book ends, which should be of a simple design. A sharp 'a" chisel is used to make small mortises in the centers of the bases and uprights of the book ends. The extensions on the feet and hands of the cutouts are fitted into the mortises and fastened with glue. For further strength, small flathead acrews can be inserted through the book ends into the plywood extensions. The wood may be finished with two coats of clear varnish, but apply only one coat on the photographs. Any simple design may be used for the book ends.—C. C. COOLEY.



Blocking Out a Negative for Temporary Use

WHEN parts of a negative are to be blocked out temporarily, the opaque may be painted on the glass of either the printing frame or the negative holder as illustrated at the right. This saves the difficulty of washing the opaque from the negative; it can be wiped from the glass in an instant with a damp cloth when the printing is completed.—CLIFFORD LEESTMA.



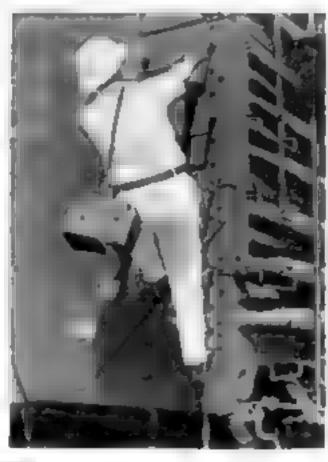
With this method the opaque can be wiped from the glass easily, and the negative is not touched

Pockets in Focusing Cloth Hold Camera Accessories

PHOTOGRAPHERS who use view cameras and do much of their work outdoors will find that a pocket sewed on either side of the focusing cloth will be convenient for temporarily placing film holders and other small accessories where they can be easily reached when needed. To maintain a balance, the weights in the pockets should be about equal.—C. E. HENDRICKSON.

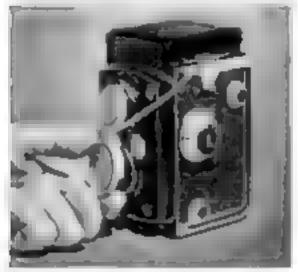
Detachable Sling Strap Helps in Handling Large Camera

Every photographer who works with a bulky camera will find it advantageous to use a detachable #ling strap. The one illustrated is heavy sole leather, 1" wide and 48" long, with a buckle adjustment for shortening it to 26" and with French dog-leash maps at each end. For use with cameras of the type shown and certain other equipment, it is necessary to provide ring plates for attaching the snaps. A strap can be made to order at any leather shop.—J. H.





The strap safeguards the camera and allows free use of both hands when the photographer has to climb up to make a picture. It may be used as a safety belt



Lens Cap Attached to Camera by Means of Rubber Band

It is not necessary to search through various pockets of your clothes for the lens cap after using your camera if you attach it directly to the camera with a rubber band, as illustrated at the left. The cap will hang out of the way when not wanted, yet it is always ready to be immediately replaced over the lens when you have completed taking pictures.—Oliver Bandelier.

LIGHTING FOR COPY WORK

The light must be flat and as even as possible. Because the eye can evaluate shadow density more easily than light intensity, it pays to hold a card as shown in the center of the location to be occupied by the print. Compare the shadows and arrange the lights till they balance.

Glossy surfaces Place lights to avoid any surface reflection to the camera. At times it is necessary to mask the entire camera (excepting the lens) to prevent its reflection.

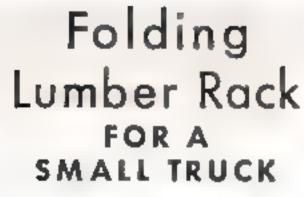
Rough surfaces. If well-diffused lighting fails to remove difficulties, the print is often photographed while being held flat under water.

Torn, crumpled prints. Ferrotype the face to glass and photograph through the glass. (Any cracks or surface markings not obliterated by this treatment must be retouched on the negative and following print.)

FOPULAR SCIENCE MONTHLY SHOP DATA FILE









O SAVE the

trouble of using a large truck to deliver small orders of long pieces of lumber, a lumberyard fitted a folding rack on its pick-up delivery truck as illustrated above. Made of Long pieces of lumber are easily carried on the rack, which folds up on the floor of the truck when not in use, as at left

2" by 4" material, the rack is boited to the sides of the box body so that it rests extended on the open end-gate when in use and folds back on the floor compactly when not needed. In this

way pieces 16' long, or even longer if the front of the load is weighted, may easily be carried.—EMIL PEARSON.



By screwing a so-called "solderless connector" of the type commonly used in electrical work on the end of a short piece of wire solder, as shown above, you can hold the solder without incurring the danger of burning your fingers.—V. H. BARRINGTON.

Rubber Band Protects Pull-Chain Socket

Here is a simple means of protecting a pull-chain socket from being broken by an unusually hard pull on the string attached to the chain. I added a heavy rubber band or two between the chain and the string and they absorb sudden shocks. This idea can also be used for insulating a chain in damp places.—Kenneth Gray.



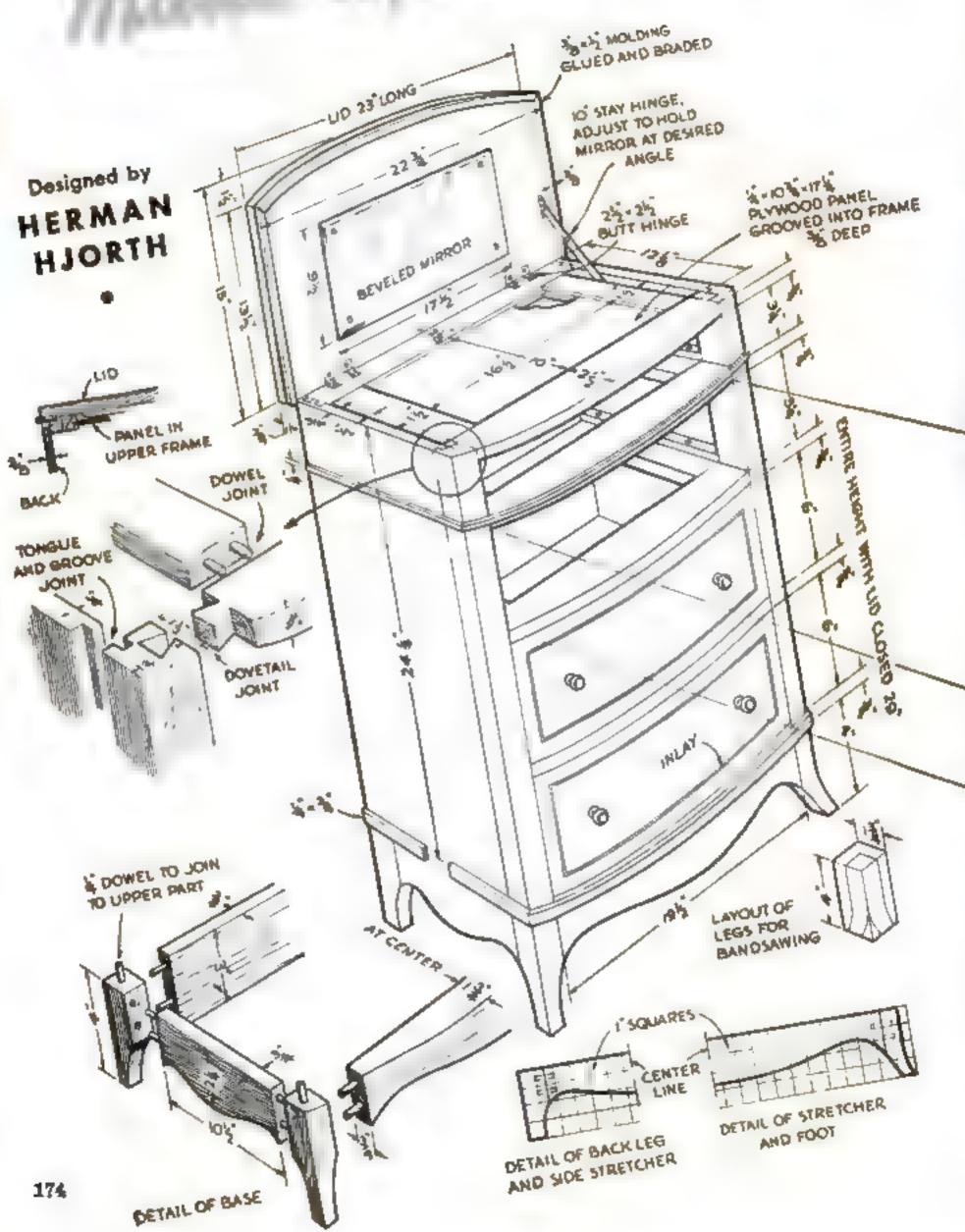


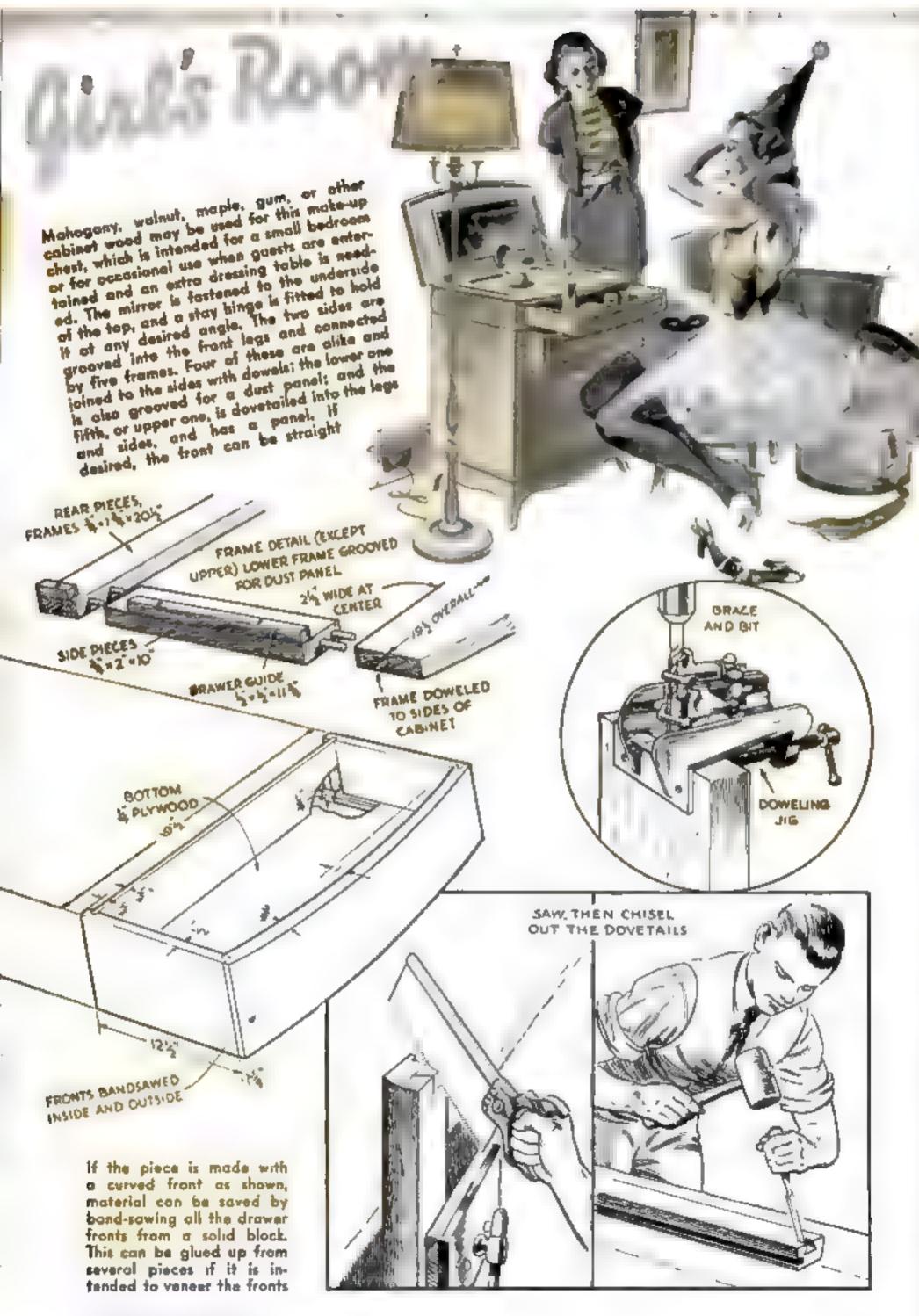
Knurled-Nut Roller Safeguards Check

As A GUARD against checks being raised, a protector can be made from a sharply knurled adjustment nut. A piece of rod is chosen to fit inside the nut and form the bearing, and the nut is mounted between two pieces of sheet metal, bent as shown and slipped into a handle like nut.



SPACE-SAVING MALLE-SAVING THAT CHEST FOR C





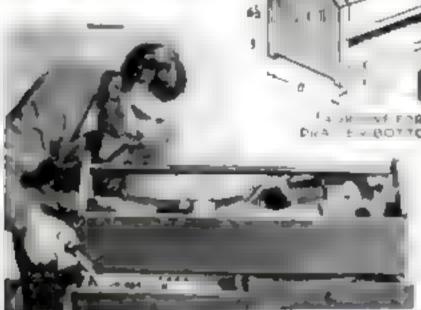
Drawers Improve Tool Boxes Used for Repair Work

FOR repair work in and about the house or farm, it is convenient to have a portable tool box with one or two shallow drawers or trays to hold small hand tools and the like. The drawings give dimensions for a small household tool kit. The two ends are band-sawed and dadoed %" deep and %" wide to receive the tray bottom and drawer slide, both of which measure %" by 8" by 19%". They are glued and nailed in place. Cut three pieces %" by 24" by 18%" for the sides of

the tray section and drawer stop. The handle is %" by 11%" by 18%" and is fastened with screws. Construct the drawer as shown and divide into sections.



A small household tool hit is kept immediately accessible in this box with its shallow drawer. In the photo at the extreme left is shown a larger but similar box



Rain Cap for Battery Charger

A STANDARD make of wind-operated battery charger gave trouble because rain entered the front bearing, causing rust. This was ended by cutting a hole in an empty coffee tin to fit the shaft and slipping the tin over the end of the generator.—W.S.S.

Tiny Chair Serves as Sewing Box

SIDE

(4 REQ.)

(2 REQ)

I"SQUARES



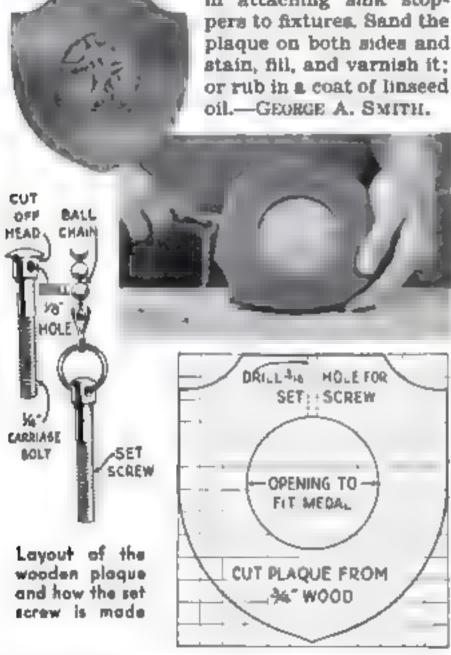


RESEMBLING an upholstered chair, this sewing box consists of nine pieces of corrugated card-board. Pad the back, arms, seat, and tiny pincushion with cotton batten and sachet powder, then cover with material to suit the taste. Attach pincushion to chair with pins or hold it in place with thread.—MRS. K. R. SIPPLE.

Large Medal Displayed in Reversible Plaque

IF You have received the American Legion School Medal or any similar award, it may be attractively displayed in a reversible walnut or mahogany plaque of the type shown. The opening for the medal can be cut with an expansion bit, if available; otherwise it may be sawed out and accurately filed and sandpapered to a snug fit. The set screw, which is made from a 1/4" carriage bolt, is allowed to cut its own thread in the 3/16" hole in the wood. For the chain, obtain from a plumbing supply house a 9" length of ball

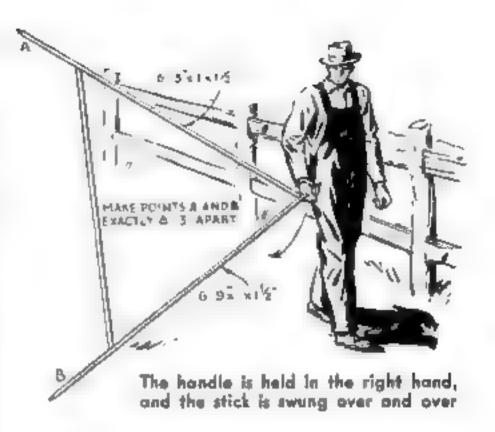
chain of the variety used in attaching sink stoppers to fixtures. Sand the plaque on both sides and stain, fill, and varnish it: or rub in a coat of linseed



Old Carbon Paper Heated to Renew Its Surface

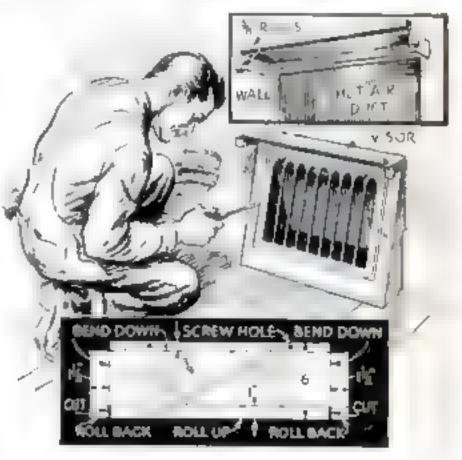


IN AN emergency a badly worn piece of typewriter carbon paper can be made usable by heating it over a radiator or a very low gas flame. The heat softens the ink and causes it to run together smoothly again, eliminating worn spots.-W. S.



Giant Wooden Dividers Measure Acreage

By USING the glant dividers shown, one person can measure the acreage of a tract of land almost as fast as he can walk along two sides of it. The points are brought down each time at approximately the same distance from the fence or line of measurement. Each turn of the stick measures off exactly one-half rod. Eighty spaces thus equal forty rods or the length of the side of a square one-acre plot.—CLIFFORD W. BERG.



Dust Visor for Register

Every home owner who uses a hot-air furnace will appreciate the 18-gauge sheetmetal visor shown above. It eliminates the smoke and dust streak on the wall above heat registers by directing the warm-air currents away from the wall and out farther into the room .- EVAN W. BAKER.



Handle Attached to File for Flat Surfaces

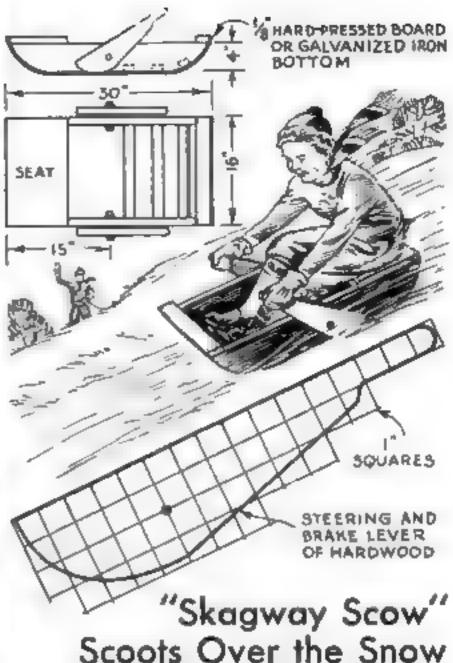
FILING large, flat surfaces is easier if a wooden handle, taken from an old plane, is attached to the file. A hole is drilled in the tang of the file to take a stove bolt long enough to reach through the handle.

Pliers Force Brads into Picture Frame

For inserting small brads in the back of a light picture frame, a pair of slip-jaw pliers are more convenient than a hammer. Open the pliers to the "wide"



notch, hold the nail in position with the other hand, and apply a firm, steady pressure. The outer jaw of the pliers may be padded.



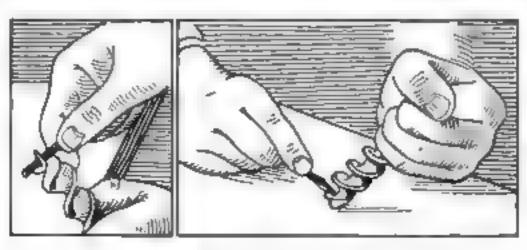
So-called "Skagway scows" are fun-provoking snow coasters made without runners. The one illustrated above is of especially simple construction. The bottom may be either hard-pressed composition board %" thick or a piece of galvanized iron. The two hardwood side levers enable the scow to be

steered or braked to a standstill.—H. S.

SHARPENING AUGER BITS

[WOODWORKING]

Dull or damaged auger bits may be sharpened with a small flat file or an auger-bit file. The spurs are the vertical cutting edges which score the circle before the horizontal cutting edges, called the lips, cut into the wood. 1. Hold the bit against the edge of the bench with the cutting end above it and file the spurs on the inside until a fine burr is formed. Re-



move this by rubbing the outside of the bit lightly with a slip stone. 2. File the lips on their upper sides while holding the bit at an angle and resting the screw on the bench top. Remove the burr as before.

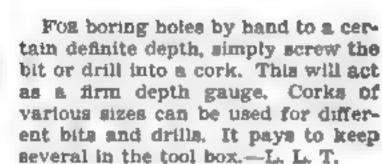
POPULAR SCIENCE MONTHLY SHOP DATA FILE



Rubber Cement Prevents Folder from Slipping

ONE of the objections to mounting photographs in cardboard folders with easel backs is that a gust of wind easily causes them to slide to the floor when placed on a polished plano top or table. Give the bottom of each folder a coat of ordinary rubber cement and the trouble is overcome, because the cement provides a nonslip surface which is not harmful to the furniture.

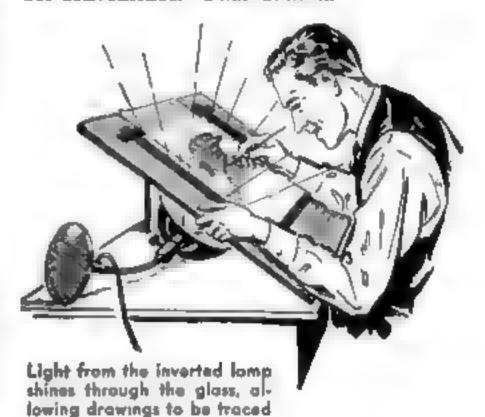
Cork on Auger Bit Acts 1 as a Depth Gauge



A Glass Drawing Board for Stencil Tracing

DRAWINGS and diagrams can be traced on duplicator stencils by using a sheet of plain or ground glass taped in place over an opening in a piece of wall board. This is propped up over an inverted desk lamp as illustrated below.

For permanent use, set the glass in flush with the surface of the wall board and tack reenforcing strips around the outside of the board and under the glass. I prefer this type of device to an expensive tracing outfit because it takes little room and can be set up at any convenient angle right on my deak. A wooden prop may be hinged to the back for convenience.—FRED CARTER.



NUMBER OF WIRES IN CONDUITS

[ELECTRICAL]

When wiring is to be done in conduit or thin-wall tubing, it is necessary to know the number of wires allowed in the various sizes of conduits. An attempt to use too many wires will cause difficulty in pulling them into place and may damage the insulation. The following table shows how many conductors of various sixts can be used in conduits of 1/4" to 21/4" sizes.

Bixe of		Numb	er of co	nductors	la one	conduit or	ur tubing		
Wires	1	2	3	4	5	8	7	8	Ð
18	14.	36	14	36	He.	塘	S ₂	14	1/4
16	36	36	16	- 36	16	36	56.	36	34
14	1/4	36	16	16	- 36	36	裁	1	1
12	36	36	36	- 16	- 56	1	1	1	214
10	14	56	36	36	1	1	14	214	114
8	36	36	1	1	114	114	3125	124	14
- 6	36	1	136	2%	114	114	2	2	2
4	76	1%	136	1%		3	3.	2	24

POPULAR SCIENCE MONTHLY SHOP DATA FILE

PINOCCHIO

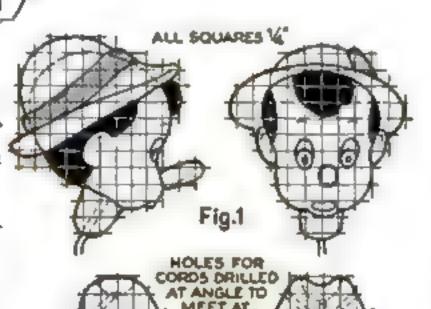
HOW TO DUPLICATE THE AMUSING

NOCCHIO, the wistful puppet created by Geppetto, the wood carver, in Walt Disney's second full-length production, is an inviting subject for either a homemade puppet or an amusing and companionable little doll. The accompanying illustrations show how to go about making one patterned after the original, which was created by the Disney model department as an inspiration to the animators drawing Pinocchio.

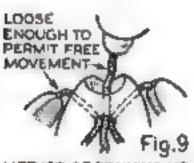
If you are an expert wood carver yourself, the head might

be fashioned from a solid block of soft white pine and the nose inserted (Fig. 1), but a surer way to achieve a fair likeness is first to make a clay model. From this a plaster-of-Paris mold is taken, and the head is cast in plastic composition wood (Figs. 2, 8, and 4). The hat is made in the same way as the head and glued on.

The casting process will be found simple if the steps are carefully carried out as illustrated. Note, however, in the step marked Fig. 4E

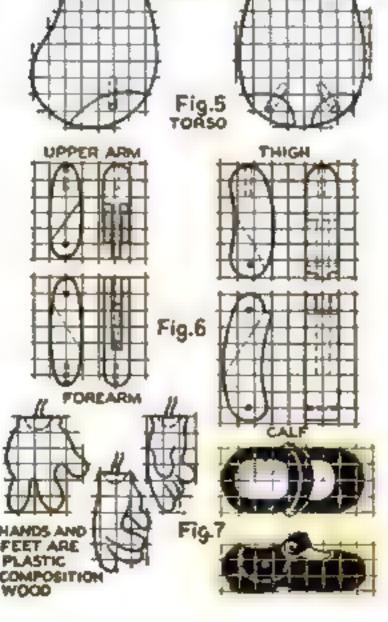


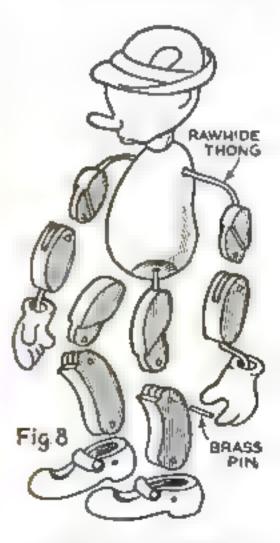
By HI SIBLEY



METHOD OF DRAWING UP HEAD AND ARM CORDS

If you want to make a 9" tall Pinacchio, lay out "4" squares for copying the variaus parts. Change the squares to 3" for a 13" model





thePUPET

LITTLE MODEL WALT DISNEY'S ANIMATORS USED

it is not necessary to fill the mold with watery plaster. Just pour a little inside and swish it around to form a coating and prevent the wood composition from drying and shrinking. The joint where the two halves of the head come together should be filled and the whole sand-

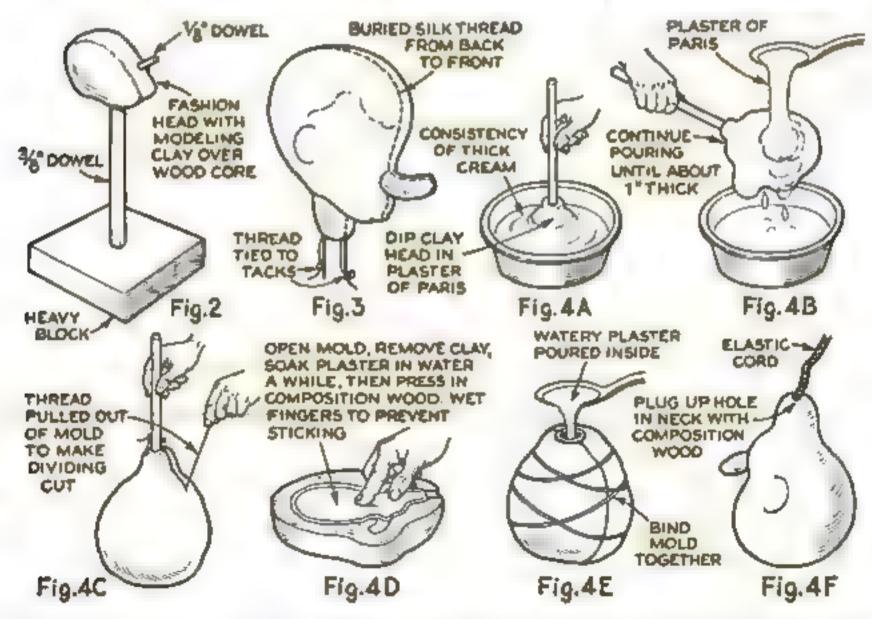
papered before painting.

The torso is carved from a solid block of soft white pine (Fig. 5). and holes are drilled as indicated for the thongs to which arms and legs are attached, and for the elastic in the neck. The latter is a sort of ball-and-socket joint so that it may be turned and twisted within reasonable limits.

Legs and arms are of maple, although if they are to be painted flesh color, white pine will do. These pieces are slotted and jointed as in Fig. 6. For a doll, make the slots

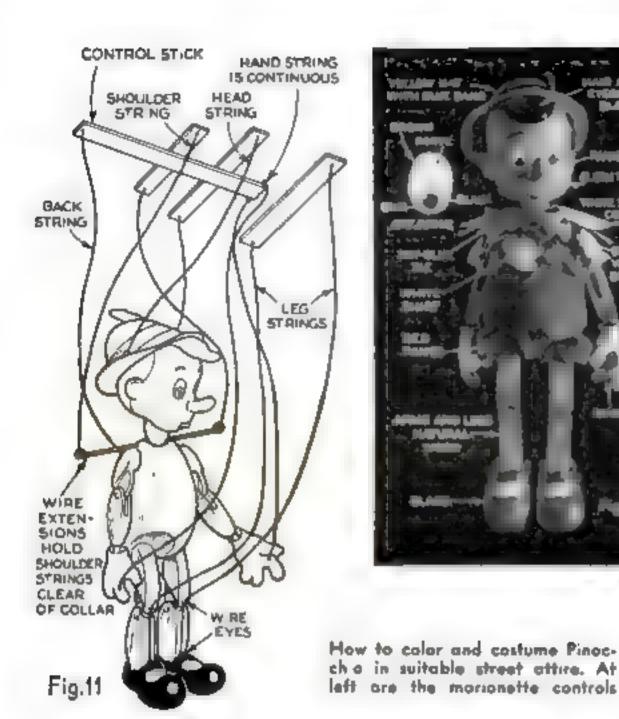






Step-by-step sketches to show the method of modeling and casting the head. The hat is made similarly

FEBRUARY, 1940



fit snugly so they will remain in any desired position, but for a marionette the joints should be very loose.

Hands and feet are cast in the plastic composition like the head, and the shapes are given in Fig. 7.

The assembly is illustrated in Fig. 8. Raw-hide thongs are driven into holes in the upper arms and thighs, and fastened with glue or thin wedges. Costume and coloring are shown in Fig. 10.

There are various methods of attaching strings to a figure of this kind if it is to be used as a marionette, but one of the simplest is shown in Fig. 11. The wire extensions for the shoulder cords have the

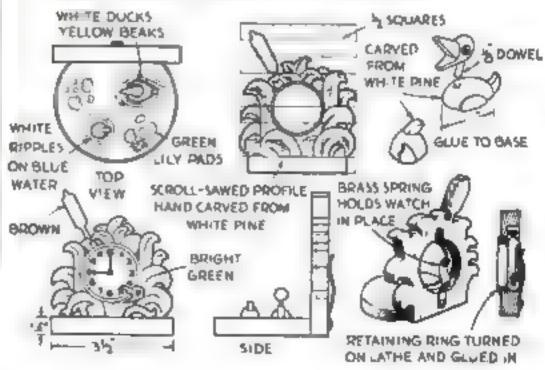
advantage of giving better control and hold the strings clear of the stiff white collar,

And Here Is a Colorful Little Clock by Geppetto



An original Geppetto clock and, at the right, a simple adaptation of the design for holding a dollar watch

GEPPETTO, the indefatigable wood carver who made Pinocchio, filled his shop with all manner of unique cuckoo clocks. This one can be adapted to serve as a desk ornament. A hand-carved background of rushes supports a dollar watch, and in the foreground is a painted pool with a pair of ducks, one of them "headin' south." Jig-saw the back wall from white pine and carve in the design. The watch is set in a circular opening, being held in place by a brass spring. If a lathe is available, turn the retaining ring of hardwood; otherwise carve it out. The ducks are whittled from white pine.





Workshop Clubs Increase Activities as New Year Begins

NTENT on getting the most out of their hobby, thousands of amateur craftsmen throughout the United States and Canada are participating in a variety of interesting programs arranged by their local home workshop clubs. Reports to the National Homeworkshop Guild from club secretaries indicate that more activity is taking place

at present than ever before. The Christmas toy project has been successfully completed, and now the members are turning their attention to other projects. Here's the latest summary of news prepared by the Guild:

LEROY, N. Y.—Two prizes are given each month for the best projects made by members and exhibited at the meetings. All the monthly winners will be eligible for competition for a grand prize to be awarded March 11. Joseph Kibler is contest chairman, assisted by R. S. Kellogg, George J. Sequerth, Vincent Lapp, and H. L. Canfield. The fifth annual display contest is scheduled for March 25 to 30

SEATTLE, WASH.—"We are planning a big year and hope to get several prominent speakers; also silent and sound moving pictures," reports E. R. Landers, who was recently elected secretary-treasurer. The other officers are M. L. Eggleston, president, Harold Wirkman, vice president; G. F. Fitzgerald, librarian; E. E. Park, shop foreman. Post cards listing coming events

are mailed to the members periodically.

NATION'S CRAFTSMEN FLOOD GUILD OFFICE WITH REPORTS

FEBRUARY, 1940



NEW BEDFORD, MASS.—Separate benches for all members of the Timbercraft Club are being constructed in the club workshop. A fund is being raised to purchase additional power tools, Members have been requested to report to the secretary

all the major projects they make. Last year's

total was fifty-two.

CHICAGO, ILL.—Members of the Way

Homeworkshop Club have completed

their lawn-ornament project.

PEEKSKILL, N.Y. Leonard H. Buckton, industrial arts instructor at the high school, demonstrated sand molding. After explaining various units of equipment and the details of preparation, he made castings of brass and a zinc alloy. The club celebrated its sixth anniversary with a dinner in November. A recent meeting was held at the home of Fred Gallagher, who exhibited his equipment for polishing woods and metals. Another meeting was held at the home of Thomas Monteleone. Mr. Buckton showed moving pictures.

PUT-IN-BAY, OHIO — "The club has rebuilt part of the school basement and is making it into a shop," reports Secretary Edward Cooper. "We have built two brick walls and are now erecting a fireproof door between the furnace room and the shop.

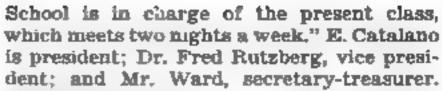
Local organizations are contributing tools for our use."

NEWTON, MASS.—
Recent meetings of the Homecrafters have been held at the homes of Bruce Bear and Fred Ryer. Browning Baker demonstrated uses of wood-turning tools, and Mr. Cole talked on plywoods and veneers.

BEAVERLODGE, ALTA., CANADA —

Projects completed by members include collapsible tables, coat racks, bookcases, flower stands, and end tables. "The workmanship is still alightly amateurish, but is improving gradually," Secretary Hubert Sumner says.

SHREVEPORT, LA.—"Our membership consists of professional men who like diversion from their daily work," reports S. K. Ward. "Last year we had 27 members; this year we expect to reach 50 and to organize two hobby classes. H. F. Rush of the Shreveport Trade



SHENANDOAH, PA.—A club shop has been established in the basement of the home of Joseph J. Polityka, secretary. Wall bookcases, with deak and chair to match, are being constructed at present. The design is a modern and original one.

OKLAHOMA CITY, OKLA,—A moving picture "The Potter's Wheel" was shown recently, and a demonstration given of screw

rutting on the lathe. The club expressed sympathy to S. Tolley, a member, who lost his mother when the S. S. Athena was sunk

A piece of furniture will be auctioned off, and half the proceeds given to the Community Chest. Toys for the local poor children made by members were displayed in a store window before they were distributed.

OTTAWA, ILL. — Robert Burns, local representative of a promi-

nent lathe works, demonstrated how to use a metal-working lathe and exhibited several models he had made that are operated by steam and gasoline power. Roland Kleinhans, of Utica, Ill., exhibited a partially completed model steam locomotive he is working on. The meeting was held in the shop of Ivan Warrick, The following meeting was held at the South Ottawa Town Hall where Dick Littleman demonstrated metal and woodworking power tools, and showed the members how to use them.

CANTON, ILL.—Harold Johnson, highschool instructor, talked on metal spinning and was so well received that a subsequent meeting was held at the high-school shop,

where he gave a demonstration. New officers are Keith Hickman, president; Dale McLam, vice president; D. V. Tolle, secretary-treasurer; Scott Shroyer, librarian; John Hardin, publicity chairman.

DAYTON, OHIO —
Toys made by the Gem
City Homeworkshop
Club for the city's poor
children were presented
to the Junior Chamber





of Commerce at a dinner in December. Toy ducks, wheelbarrows, chairs, doll beds, games, and small ironing boards were among the 200 toys. Frank Lehman won an award for a circus wagon he had made from a cheese box.

LYNN, MASS.—New workshop equipment has been purchased for the club's shop. Plans are under way for holding an open house soon. President R. A Barbeau recently demonstrated

how to turn Queen Anne legs for furniture. Reports for the past season show that A. Gilbert completed the greatest number of projects. J. Termini, it was decided, had shown the greatest improvement in woodworking

COLUMBUS, OHIO—Carl L. Phalor has been elected president of the Homecraft Club, writes Tudor Wilson, corresponding secretary, who says: "A large part of the club's success has been due to Mr. Phalor's



whole-hearted devotion to the promotion of the club during his secretaryship of several years. Tribute must also be paid to the retiring president, Dr. William T. Palchanis, for the splendid programs he arranged last year." The annual meeting was held at the Southern Hotel, and reports were given on last year's toy project and the successful showing the club made at the Columbus Hobby Show. Other officers elected were Homer Faust, vice president; F. E. Hoop, secretary-treasurer; W. S. Lynch, Dan D. Fulmer, and Ralf Sears, board of governors.

BLOOMFIELD, N J. - William Hassel

told the members of the Berkeley Homeworkshop Club about his hobby of collecting and making replicas of old locks.

RACINE, WISC. —
The club hopes to have a permanent location soon. An exhibition of soap carving was given by LeRoy Smith.



GUILD MEMBERSHIP IS OPEN TO YOU!

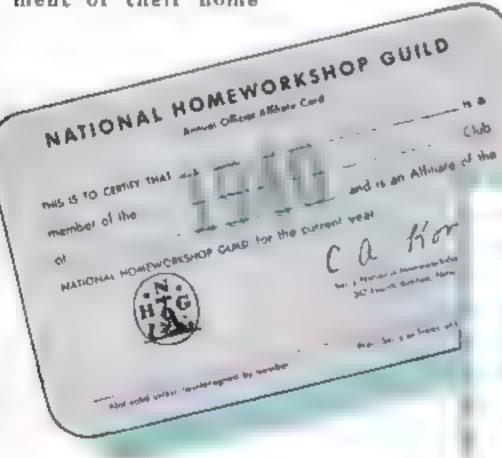
Do you own one of the cards pictured below? It indicates that the holder is a member of a home workshop club affiliated with the National Homeworkshop Guild Wideawake craftsmen everywhere have come to realize that the enjoy-

ment of their home

workshops increases greatly when they meet with others interested in the same hobby. Mutual shop problems are discussed, demonstrations and talks given, and industrial moving pictures shown.

The Guild was formed for the purpose of helping craftsmen get together, and all its services are free. Complete information

The Guild was formed for the purpose of helping craftsmen get together, and all its services are free. Complete information on how to start a club in your neighborhood and an application blank for a free charter will be sent without charge.



Every craftsman should own a Guild card. Use the coupon at right to learn how you can start a club

National Homeworkshop Guild 347 Fourth Avenue, New York

I want to start a home workshop club so that
I in enjoy its fellowship and receive the many
ser can furnished by the National Homeworkshop
I Please send me your special builtin to ling
I to do this For your use in mailing the in
I resident I am inclusing a large (legal size) selfi ressed, stamped envelope.

NAME

ADDRESS.

CITY RTATE (Please print very clearly)

Hand Tools for



Special Purposes

DECORATIVE METAL WORKING, AND FORGING

What is a router?

This is a flat plane with a chisel-bit, adjustable for depth. It is used for trimming the bottoms of dadoes to a uniform depth.

Of what use is a scrub plane?

It is a narrow plane with a single, round-posed cutter and wide throat, used for roughing off excess atock. A similar tool, the furring plane, has a double-arched sole that permits fuzz and grit to fall out.

Are there any other planes of interest#

There are many forms of scraper planes and holders, also the circular plane, having a thin bottom that can be sprung to fit a curve worked on, such as the top of an arched door, or for smoothing the head jamb in the arch.

Why not substitute one adjustable auger bit for several solid bits?

Convenience counts here. The expansive bit must be adjusted for size; and to insure accuracy, it must be tested on a waste piece of wood, so that a little time is lost. Two or three bits of commonly used sizes can be



OUR \$15-a-month budget workshop has now reached a more complete stage. The tool cabinet is finished and hangs above the homemode bench. A varied callection of well-chosen hand tools is neatly racked up for convenient use. Although not visible in this photograph, drawers have also been installed in the bench, and Mr. Love's young friend, Robert Jaacks, will be able to keep his shop orderly from the first. Here he is using an ouger bit with a depth gauge, which is shown larger in the insert

PART III
OF A NEW
SERIES FOR
BEGINNERS
By
Edwin M.
Love









A wooden miter box, corefully used, gives good service for a time, but a metal one, right, is infinitely better

bought for the price of one expansive. On the other hand, for boring holes larger than 1" in diameter, an expansive bit is convenient, as large auger bits are costly.

Couldn't a breast drill double for a hand drill!

If much metal drilling is to be done, this is

a good idea. A light hand drill, though, is convenient for boring holes for drawer-pull bolts and the like because it can be held back to prevent splitting of the wood inside when the point goes through. For this reason, too, the hand drill is preferable for most wood drilling, although the push drill, which can

be used with one hand, certainly has its place.

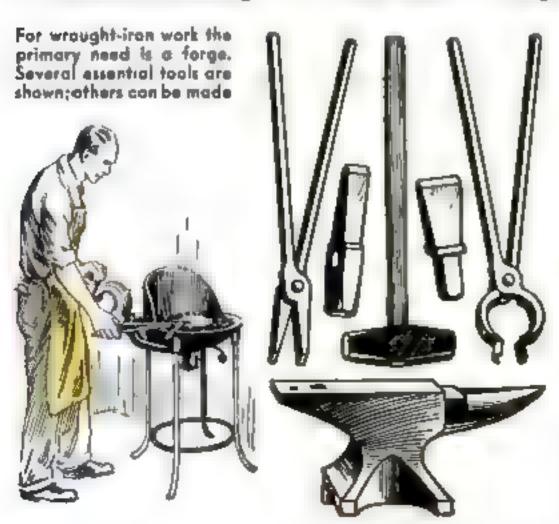
What are also assistant and

What are plug cutters and dowel pointers?

The plug cutter cuts a disk of wood to plug a hole that a screw head has been sunk into. If the grain of the wood is matched, such a plug, even on work with a stained or natural finish, can hardly be seen. The dowel pointer chamfers dowel ends so that they will enter dowel holes easily.

Should a home shop have a miter box‡

A miter box is indispensable for cutting moldings to go around cabinets, for picture frames, and similar jobs. A wooden box will serve quite well, but becomes inaccurate with use, as the guides wear. There are fairly inexpensive



Mallets Hammets RAISING FORMING **BLOWHORN STAKE** TRAY STAKE CRIMPING STAKE PURPOSE STAKE IRON Chasing, raising, belling hammers: rawhide and horn mallets; various stakes; snarling iron; dapping die miter boxes on the market for use

with ordinary saws. The best, however, are fitted with their own wide back maws, and have locking adjustments for cutting any angle, as well as depth gauges and attachments for duplicating lengths.

What tools are needed for craftwork in sheet metalf

The list is rather short, considering the variety of work that can be done. For simple

flat work, etched or plain, such as fobs, tags, and paper knives, the following will serve: Small cold chisel; machinist's ballpeen hammer, 🔏 lb.; tin snips, 10". For saw piercing, chasing, and bending: Chasing, forming, neck, and planishing hammers; hand drill with drills; jeweler's saw frame with blades; center, chasing, and dapping punches, the latter with die; leather or canvas sandbag; stake; tinsmith's blow horn, 14 lb. For beating down, fluting, modeling, raising, and necking: Wire polishing brush; belling hammer; horn and wooden maliets; snarting iron; bottom and tee stakes, A blowpipe for use with gas, and a bellows for

> draft are also needed. although a blowtorch can sometimes be used. Various hardwood blocks for anvils, and crocks for the cleaning acid (pickle) are required.

What is needed for forging?

The primary need is the forge. One catalogue lists forge with an 18" hearth, complete with blower, at about \$7. If a motor were at hand, the blower

could be adapted for power. A 70-lb. castiron anvil costs about \$5.50. Necessary tools are as follows: Cold and hot chisels with handles; anvil hardy, about 14"; flatter, 21/2" face; fuller, top; blacksmith's crosspeen hammer, 2 lb.; sledge, 8 lb.; punch; two or three sizes of swages; straight-lip and hollow-lip tongs.

(TO BE CONTINUED)

Electric Winder Turns Hand-Loom Bobbins

MANY who do hand weaving find that bobbin winding is a very tedious operation. An electric winder can easily be made, however, from a small polishing head costing less than a dollar, a steel or hardwood spindle turned as shown in the detail drawing above, a piece of 1/2" steel shaft 4" long to use in the polishing head, and a 1/4" coupling for connecting the spindle and the shaft. These are assembled and belted to a small motor, such as a sewing machine or fan motor. The bobbin is slipped

on the spindle, the yarn given one or two turns around the bobbin, and the motor started with one hand while the other hand guides the yarn.-JOHN H. CLAYTON,



Bobbins for a hand loom ore quickly wound on this inexpensive machine

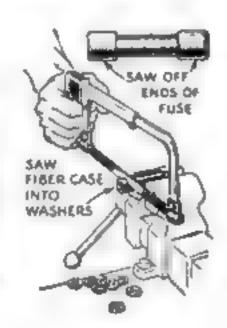


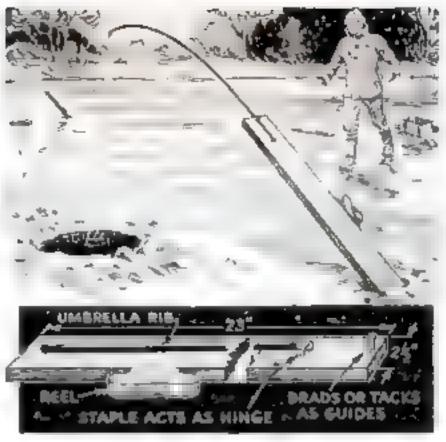
Acetic Acid Solution Cleans Water Filter

IF THE "no splash" filter on the water faucet no longer delivers an even stream of water, this may be due to a clogging of the screen mesh with calcium and other salts from the water. To clean, cork one end of the filter and fill it with weak acetic acid (or strong vinegar) and let it stand for ten or fifteen minutes.

Fiber Washers Cut from Fuses

Discarded cartridge fuses having fiber cases are a source of fiber bushings and washers. Remove the metal ends, cut the fiber with a hack saw, and smooth the cut surfaces with a file.





Umbrella Rib and Board Aid in Ice Fishing

This extra-sensitive ice-fishing outfit, which is especially good for perch, consists of a board with a small cleat, an umbrellarib, a staple, and two small brads. A loop is tled in the line and slipped over the beaded end of the umbrellarib. Being hinged on the staple, the umbrellarib folds back for carrying.—RALPH E, TILLBERG.

Inner Soles for Work Shoes

EXCELLENT inner soles for work shoes may be cut from a discarded wool-velvet rug.—HENRY A. HANSON.

POWER-TO	[WOODWORKING]				
Machine	Process or type	Britable r.p.m.	Remarks For stock about 4" thick Use slower speed for larger ligneters		
Lathe	corphing genera cutting Smothing	1 NOO 2 400			
Circular Saw	6" dia. 7" dia. 8" dia 10" dia	4 800 4 500 4 000 3 600			
Band Saw	10" dia. 12" dia. 14" dia.	500 700 600			
Jig Saw	fine bindes coarse bindes	600 to 1 750 150 to 1 300	Down and up constitutes one stroke		
Drill press	boring (% bit) boring (multiple spur) mortising	1 800 to 3 000 500 2 250 to 3 000	But size type of wood hole depth eld, govern speed		
	gallers bus galdads	max speed	Use 7 (800 to 8 000 if possible		
	eanding	1 200 to 1 500	With 3" drum		
Jointer	ball bearing	3 600 to 7 000			
Shaper		8 000			

It is dangerous to operate a machine at a greater speed than that for which it was designed.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

EIGHT PIPE LEGS SUPPORT

Table-Tennis Table

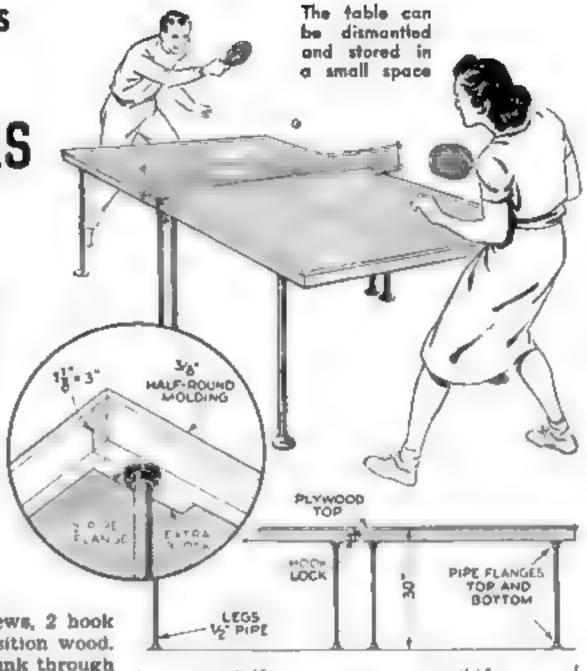
TABLE-TENNIS table that takes very little room when dismantled may be made with iron pipe lega. It is more stable, yet the expense is only slightly more than for one with wooden legs or horses.

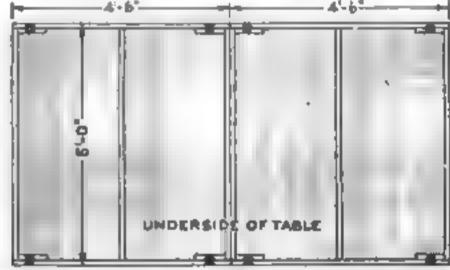
Materials: 2 pc. 3-ply or 5ply wood 4 ½' by 5', which is a standard size sold for this purpose; 8 pc. ½" pipe 27" long; 16—¼" screw flanges; 48' of 1 ½" by 3" wood (two by fours may be used, but make the table heavier); 28'

of %" half-round molding; screws, 2 hook locks, paint, and plastic composition wood.

Screws spaced 8" apart are sunk through the table top into the wood framework, and the holes filled with plastic composition wood. Pipe flanges are mounted as shown. The eight pieces of pipe for the legs can be obtained, threaded at both ends, at a local plumbing shop. At one end of each pipe a flange is placed and drawn up tight.

To give the table a better appearance, half-round molding is fastened around the edge but not in the middle where the two halves are booked together. The completed table is given a coat of shellac, then painted green (with white stripes, if desired). The legs are black.—Thomas Tullio,





Cost of this table is approximately nine dollars

Mounting Reference Sheets on a Bulletin Board



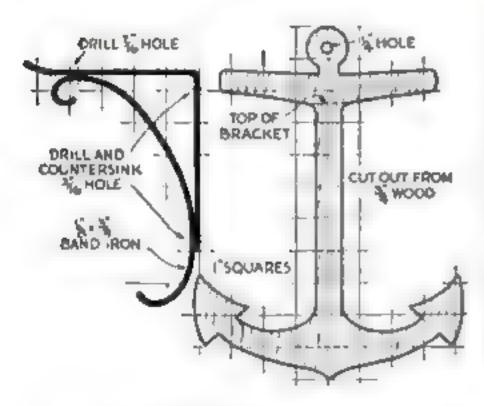
SHEETS of drawings and shop data are often protected in celluloid envelopes. When this is done, a good way of mounting the sheets for ready reference on the shop bulletin board is to use ring backs salvaged from old loose-leaf notebooks. These are mounted on the wall as shown. A sheet-metal shelf under the lower edges of the pages keeps them from sagging. Suitable envelopes can be made by binding together two sheets of celluloid with cellulose tape at the top, fore-edge, and bottom. The back edge, which is punched for the notebook rings, is left open for inserting and removing the various papers.—R. W. WAGNER.

Anchor-Shaped Lamp Hangs Up Anywhere





Usually the lamp cord of a pin-up fixture is hard to justify, but here it represents the anchor cable



HIS anchor-shaped lighting fixture is easy to make and may be hung on the wall at any place near an electric outlet. The anchor is scroll-sawed from & " wood of almost any common variety that will not readily warp. The two sections of the bracket are bent from % " by % " band iron, or from 12-gauge brass, if preferred. Drill and countersink the holes as indicated and fasten the metal bracket to the wooden anchor with flathead brass screws. Paint the whole with a gold lacquer of the variety used in bronzing house radiators, or finish in any way desired. Attach a light socket to the bracket with a short section of electrician's threaded pipe and a hexagon nut, and wire with a cord of the desired length.

How to Change Outside Window Shades to Inside

ORDINARY window shades of the type that hang outside the window casings can be cut down quite easily into narrower and neater looking "inside shades." First, buy the required num-

ber of pairs of inside-shade brackets. Nail them to the inside window
stops about 1" from the top. Remove the old shades from their
wooden rollers, measure each roller
individually to fit between the new
brackets, and saw off the end without the spring. Take the cap and
pin from the waste piece and replace them on the cut end of each
roller. New shades may be purchased for as little as fifteen cents
and cut to the width of the rollers.
They may be fastened with tacks or
tape.—Timothy F. Donovan.

SPRING ON END

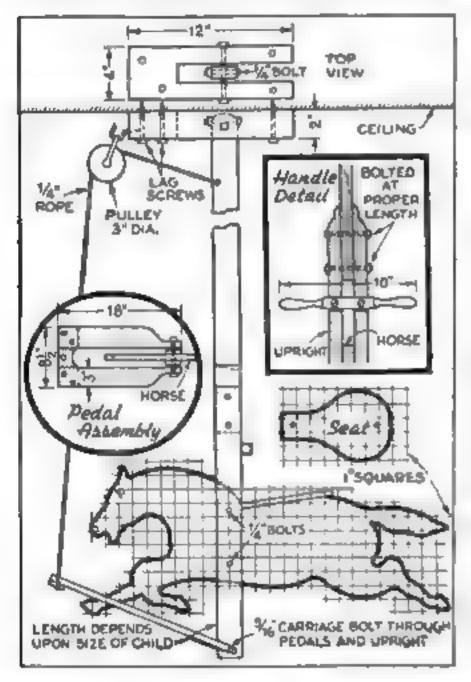
WITH FLAT PIN

PESIRED LENGTH

Swinging Pony Toy

OPERATED BY PEDALS

RESSING on the foot pedals keeps this swinging pony in motion. The harder it is pedaled, the higher it will swing. Cut the horse and seat from %" stock, preferably hardwood, and sand the edges round. The





swinging support is made from three pieces of wood, as indicated, with a handle added. In the upper end of the support a %" hole is bored for the swing pivot. Just above this hole, bore another in the opposite direction for a ¼" boit, which acts as a bearing and prevents the pivot bolt from pulling out.

The ceiling support is made from 2" by 4" stock with a slot in it to take the swinging arm. The pedals must be long enough to clear the front legs of the horse. Fasten the rope as shown. When hanging still, the front of the pedals should slope up. The horse may be made larger than in the drawings, if desired.—P. G. LACKEY.

Old Typewriter Ribbon Serves as a Stamp Pad

An OLD typewriter ribbon will serve as a substitute for a rubber-stamp pad in an emergency. Wrap several layers of the ribbon around a stout piece of cardboard cut to fit inside a small tin or cardboard box. When the stamp no longer gives a clear impression, the outer layer of ribbon can be removed to expose the next layer.—W.S.

PRIZES totaling \$100 await those readers who write the best letters telling what appealed to them most in this issue. See "Our Readers Say" Department for details.



Several layers of the old ribbon are wrapped on a piece of cordboard and placed in a suitable box

THREE POSES TO BE CARVED IN WOOD OR SOAP

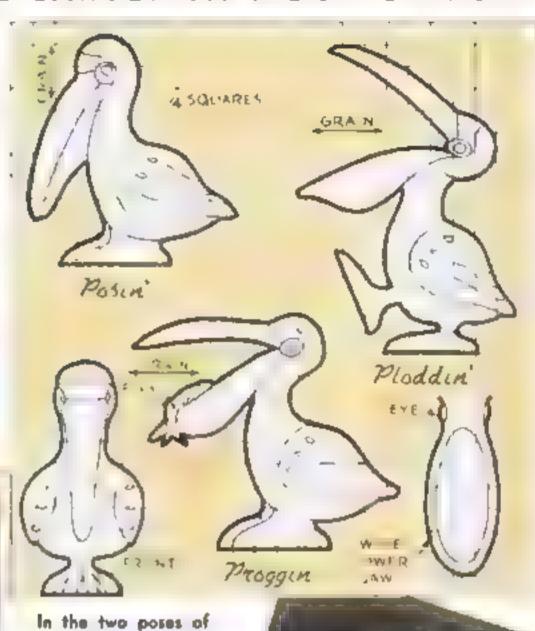




ANY of us can remember at least one expressive line to add to this old doggerel:

A wonderful bird is the pelican, His beak holds more than his belican,

It was with this in mind that these three poses of Pete the pelican were designed. All are composed of simple lines. For whitling, use 1 ½ " straight-grained white pine or basswood. Saw out the silhouette, cut away extra wood as shown, and round up roughly. Knife marks help rather than detract from the appearance. Hollow the bill when the mouth is



If carved from a scap or from a plastic as at the right, Pete should have a smooth finish

Pete with his bill open, it is necessary to hollow the bill as Indicated in the photos at the left

By E. J.
TANGERMAN

open. For the "proggin' " (or begging) pose, add a whittled fish. Finish by linseed-oiling or painting.

Pete can also be made in soap (or plastic). If you make him of soap and want him colored, use water colors daubed on, or sealing wax dissolved in alcohol.

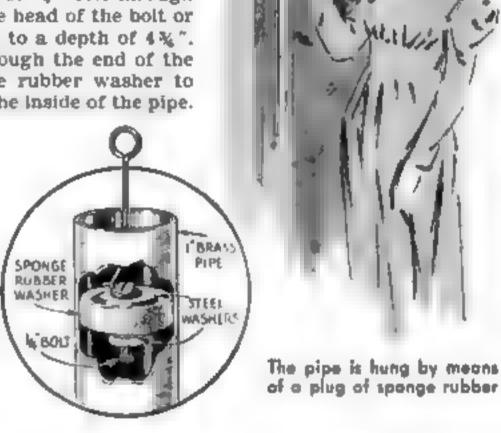
A Dinner Gong from Brass Pipe

DINNER gong made from a piece of brass pipe has a rich, full tone that can be heard throughout the house, yet is pleasant to those who happen to be near it. A 3' length of 1" standard brass pipe, 1 5, 16" outside diameter, is a good size. Iron pipe will not do. The pipe may be finished in polished brass and lacquered, or it may be nickel or chromium plated. Painting would tend to damp the vibrations.

To support the pipe, cut a $\frac{1}{2}$ " or $\frac{3}{4}$ " sponge-rubber washer so that it fits snugly inside the pipe and sandwich it between two iron washers that will drop into the pipe with a clearance of not more than $\frac{1}{2}$ ". Pass a 3-16" or $\frac{1}{4}$ " bolt through the three. Loop a piece of wire under the head of the bolt or nut and slide the assembly into the pipe to a depth of $4\frac{3}{4}$ ". With the end of the wire projecting through the end of the pipe, tighten the bolt, thus causing the rubber washer to swell and provide a nonmetablic grip on the inside of the pipe.

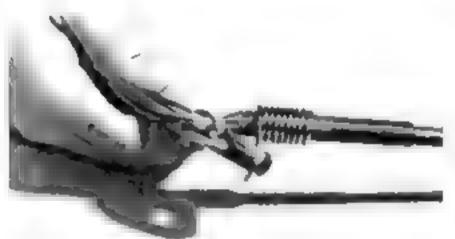
Of course, when inserting the washer, it should be sufficiently compressed so that it is a tight fit. Suspend the gong by the wire from a hook that is long enough to keep it at least 1" from the wall.

A mallet may be turned from mahogany or walnut. Felt disks glued to its faces improve the quality of tone. The gong should be struck at the top with a sharp, quick stroke, preferably from the side to avoid swinging it against the wall.—W. N. LURCOTT.



Mounting Corners Hold Titles in Photo Album

TITLES for album pictures may be typed on heavy paper and neatly fastened with ordinary photograph-mounting corners. A cardboard mask made as below may be used for outlining each tag with a pencil before cutting it out.—M. G. W.

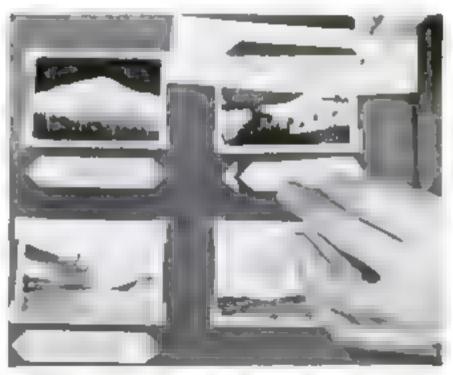


Wire Wrapping Improves Light Soldering Iron

LIGHT-DUTY electric soldering irons will remain hot longer after the current is turned off if a length of bare copper wire, No. 10 or larger, is wrapped tightly around the shell. They will also handle heavier work.

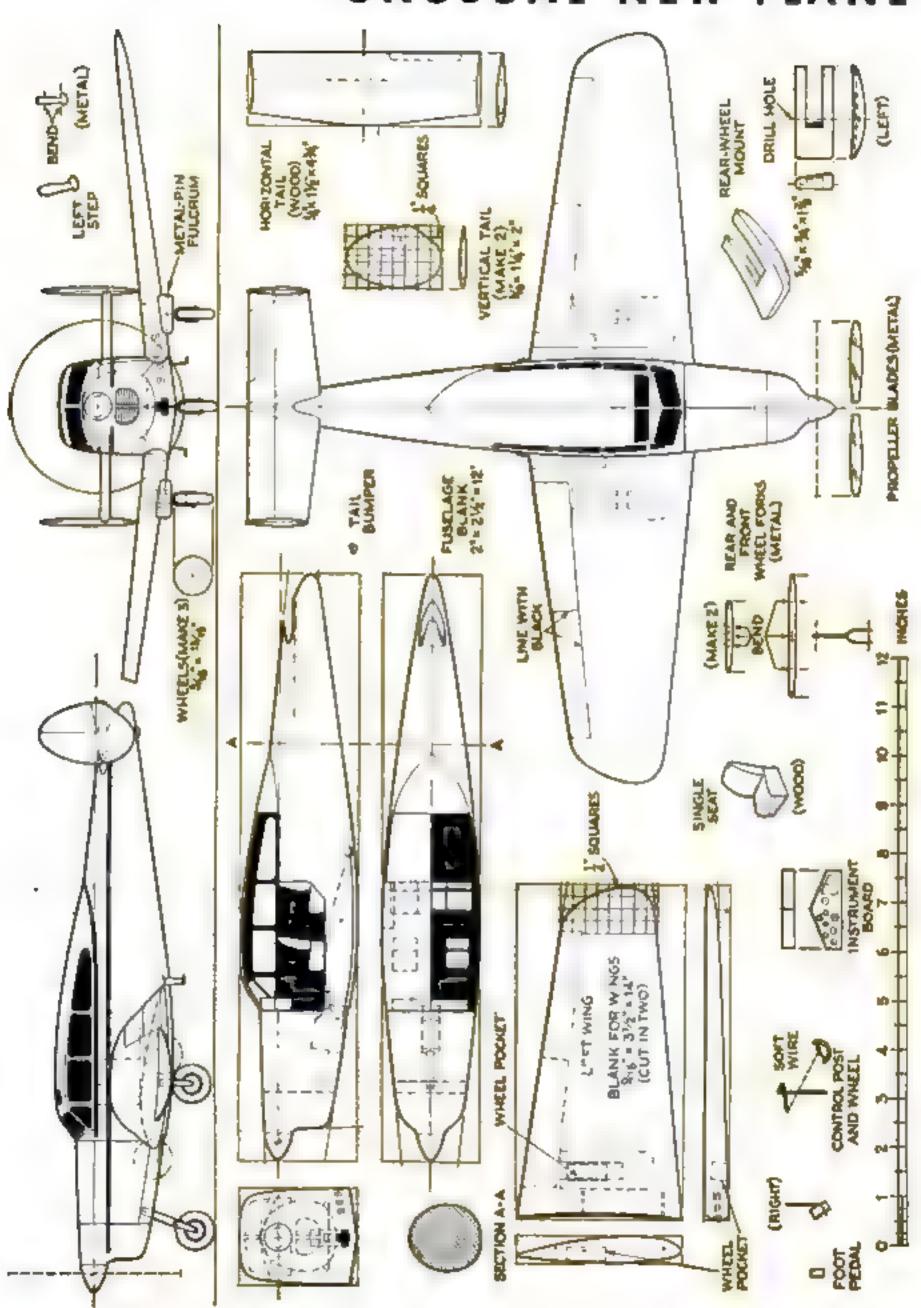
Substitute for Hollow Rivets

DISCHARGED .22 caliber cartridges may be used as hollow rivets for fastening leather work or cardboard together. The short, long, and long-rifle shells give an assortment of lengths. To spread the open end, drive in a center punch.—Norval, Weight.



Titles and template for cutting them. Photodota may be typewritten on the back, if desired

SCALE MODEL OF AN UNUSUAL NEW PLANE



The Unitwin Vega'

By DONALD W. CLARK



This trim model with tricycle landing gear is 12" long and has a wing span of 15%"

NE of the most graceful airplanes among the newer designs is the "Unitwin Vega." This beautiful ship is made in two designs, the first a five-place model, the "Custom," and the other a six-place "Starliner" intended for feeder airlines. There is no difference in size, but the "Starliner" has a longer cabin interior and a different seating arrangement from the "Custom," which is the model shown in the drawings.

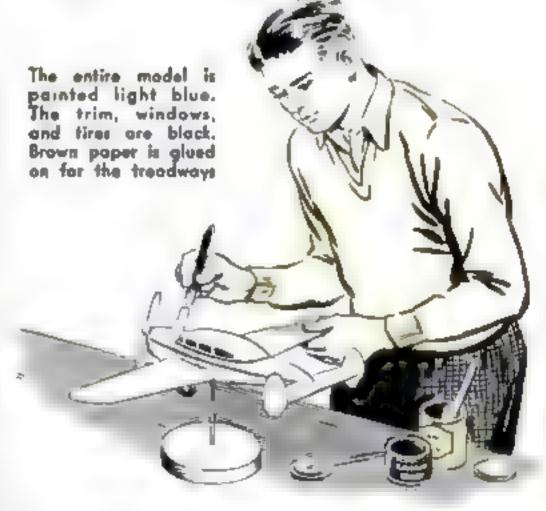
An unusual feature is the power plant—two inverted Menasco C6S engines rated at 260 h.p. each and mounted side by side. They drive a single propeller shaft through a new method of gearing embodying overrunning clutches. If one engine should fail, the other does not

have to work against the inertia of the dead engine. In addition, the failure of one engine does not cause the same tendency to turn out of line as in conventional twin-

engine designs.

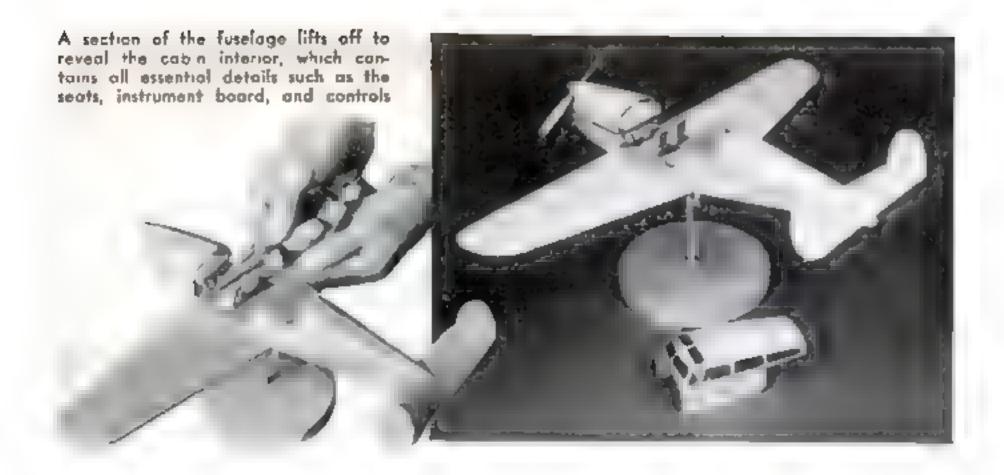
It is claimed that this ship can take off and climb to 11,000' under full load with only one engine running. On both engines it can climb at an initial rate of 1,400' per minute and maintain a top speed of 210 m.p.h. at 10,000'. The wing span is 41', length 32' 5", height 8' 6", empty weight 3,940 lb., and useful load 1,810 lb.

This %"-to-the-foot model is similar to previous models in the series, but like the Grumman fighter, the cabin space is sawed



out and carved to fit over the seats. The drawing shows how this can be done in an even more realistic manner than illustrated in the photos, but it is a delicate job to cut out the windows. Instead of making one half removable, you will find it much easier to leave the block in one piece and cut away just enough wood so it will clear the seats and instrument board. In this case your finished model will appear to be a solid one, but lifting off the shell reveals the cabin interior. The instrument board and back of rear seat will keep this cover from shifting out of place.

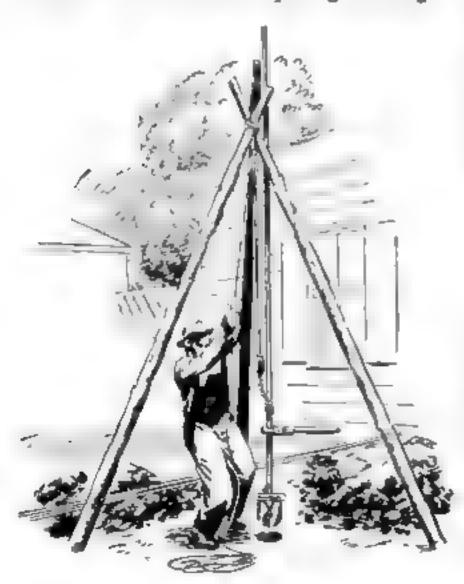
If soft wood is used for the fuselage, the wheel pockets can be cut in with a razor



blade and dug out with a small chisel. Sugar pine is a good wood to use.

After you have the body completely shaped and smoothed up, mark all the necessary lines according to the drawing and clamp it in a vise, using two pieces of thick cardboard to prevent dents. With a fine-toothed coping saw, carefully saw out the cabin portion as illustrated. The surfaces on the fuselage should be sanded smooth. Next, hold the cover block in a vise and saw deep enough to clear the seats and fittings and leave a \%" wall. To fill in the saw space, build up the edges with plastic material and when dry, trim and sand to fit.

Where the wheel-strut pins go through



the struts there will be spaces on each side. Fill these with short pieces of tubing, washers, or a gob of cement to keep the wheels centered. A tight fit will keep the wheels in either the raised or lowered position. Glue the wheel mounts to the wings. The metal propeller blades are glued in pockets as indicated.

Make the seats and instrument board of wood; the pedal hangers, control post, and wheel of paper-clip wire, and the foot pedals and instrument-board face of white cardboard. The latter should be marked out with India ink, cut to shape, and glued in place. For the seats, plane pieces to the seat profiles (like a molding), and cut to proper length. Glue the parts together securely.

The entire plane shown in the photographs is painted light blue, and all the trim is black. The windows and tires are blackened with India ink. If the windows are cut out, cover them with thin celluloid or cellulose transparent tissue. The treadways are strips of brown paper glued on the wings.

Well-Boring Outfit Costs Little to Rig Up

If the ground is suitable, a well can be bored by one man in a day with the outfit illustrated. The handle is removed from a standard well-digging auger, and a length of old %" or heavier pipe is attached. A chain is then looped around the pipe so that it can be raised and lowered with a block and tackle. The auger is turned with a pipe wrench. When the hole has been bored, the well may be cased with terra-cotta pipe and a cement curb constructed around the mouth.—R. R. HARPER.

Secrets in Stone

(Continued from page 246)

or three pieces of stone near the slide edges. These are ground down along with the specimen, and are removed before final application of a cover glass.

After the specimen has been made flat and polished on one side, wash the slide and wipe it dry. Then hold it over a flame until you can lift the mica off with tweezers. Turn the specimen, which is still fastened to the mica, over until the polished surface is down, and cement it in the center of the slide, using heated balsam as before. The mica piece, you see, is merely a convenient way of handling the bit of stone without losing or breaking it. Some types of rock material are quite delicate when reduced to fairly thin sections, and the mica makes it possible to handle them safely. You do not have to remove the mica from the specimen after it is turned over, for it grinds away quickly.

Be sure the polished surface of the specimen is flat against the glass. Then grind and polish the second surface. Work carefully, for it is easy to spoil the job by too much grinding. When the bit of rock has been reduced to a thin wafer, you will be able to see light through it, especially if it is a rock that is partially transparent to begin with. Work the piece down until it is very thin, about 1,1000° being somewhere near right. Use your microscope frequently toward the end of the grinding and polishing operations, to check progress.

Finally, when the section looks thin enough, wash it to remove particles produced by grinding. Dry it, with gentle heat if necessary, and drop some xylol on it. Then apply some Canada balsam and put the cover glass in place. You will find that the addition of balsam and the cover increases the transparency of the section and subdues surface scratches.

In this way you can build up a collection of rock sections. Using the same technique, you can mount coal, peach seeds, cherry stones and other hard, dense materials. When working fruit seeds, a flat file sometimes is quicker than a coarse stone for preliminary operations.

Granite, basalt, and many other kinds of rocks are best examined in polarized light, which produces beautiful colors in the various materials of which they are composed, and shows details of structure that are not visible in ordinary light. Other rocks, such as limestone, show to no particular advantage in polarized light.



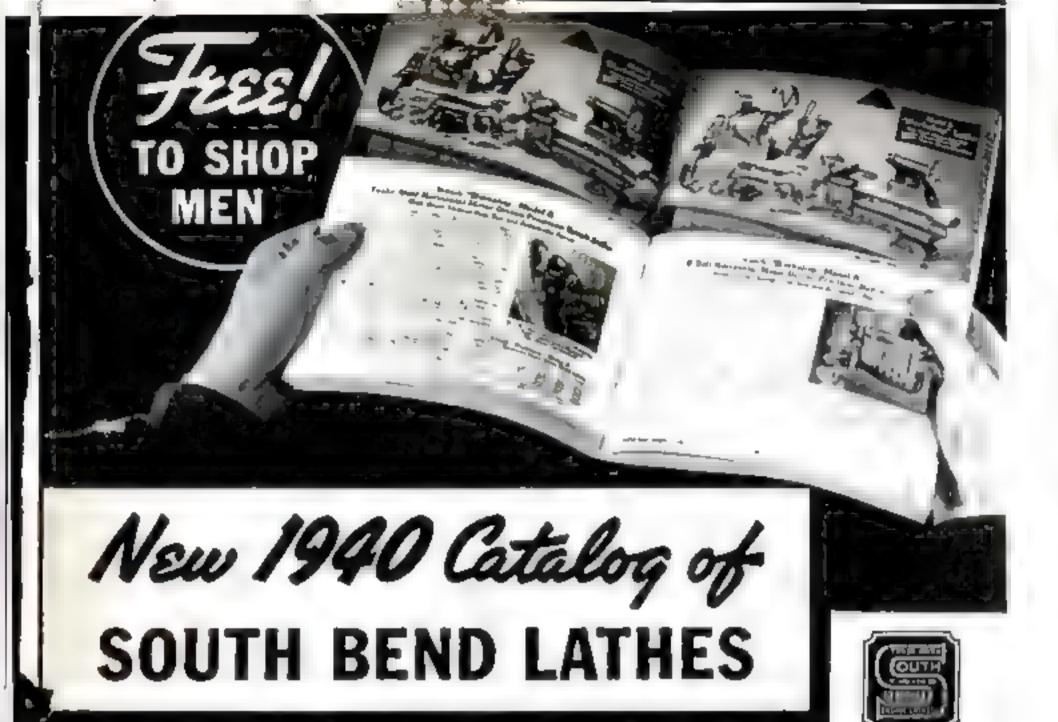


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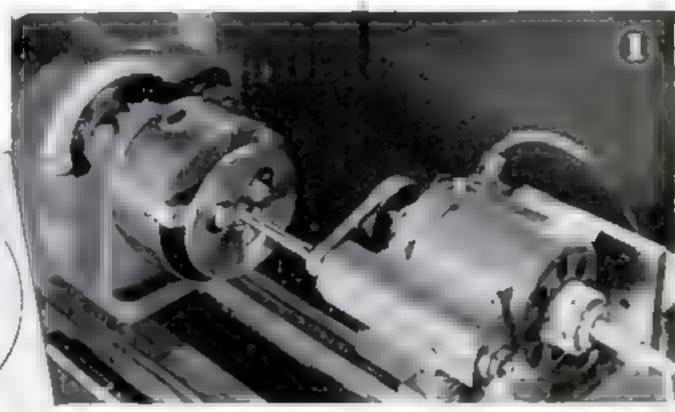
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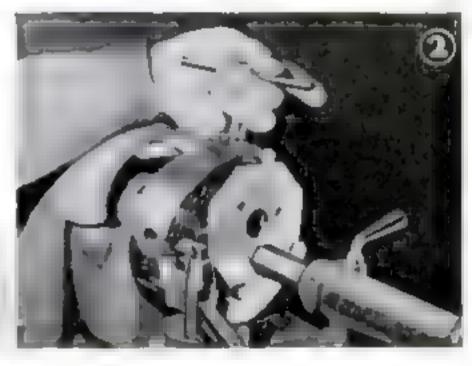
POPULAR SCIENCE :



The disk shown below puts a strain on the chuck jaws and holds them apen for grinding



Held with the disk, the jaws are ground as in Fig. 1. The method of centering the holes in the disk is shown in Fig. 2. The holes are then bared out to exactly 1" in diameter as illustrated below



Lathe Chuck

By CHESTER WARREN WOODSON

HEN the three-jaw chuck of your lathe no longer turns dead true or the jaws become bell-mouthed and therefore grip long bar stock with the back of the jaws only, it is a simple matter to make up the accessories required for grinding the jaws flat and true. This will restore the chuck to its original accuracy and eliminate the annoyance and delay always caused by

attempting to work with imperfect tools.

The general set-up for grinding the jaws

The general set-up for grinding the jaws is shown in Fig. 1. First, however, it is necessary to make a device to hold the jaws open for grinding. This is illustrated in Fig. 6. A 4" disk is cut from cold-rolled steel about 4" thick and bored to the dimensions given in the drawing. This size will fit the average small chuck, but the dimensions can, of course, be changed as necessary.

After the holes have been accurately laid



After the disk has been bared, it can be held in the three jaw chuck while its edge is turned smooth as in Fig. 4. Then the chuck laws are tightened in it as in Fig. 5 for the grinding operation. The finished disk appears below

out and drilled !," in diameter, the stock for the disk is placed in a four-jaw chuck and each hole centered accurately. The work is held in position with the tailstock dead center while the chuck jaws are carefully adjusted as in Fig. 2. Each hole, after being indicated true, is then bored out to exactly 1" in diameter as shown in Fig. 3. Once the holes are bored, the disk can be held in the three-jaw chuck (Fig. 4) while its edge is turned smooth.

Figure 5 shows the disk in position and the chuck jaws

being tightened. This puts a strain on the jaws exactly as if they were in use; at the same time the jaws are held open, exposing their tapered edges to the grinding wheel (Fig. 1).

The lathe is started and run at medium speed. As the chuck revolves, the grinder is adjusted to take a very light cut and is



To hold the set of external chuck jaws for grinding, it is necessary merely to turn a simple steel ring of suitable dimensions

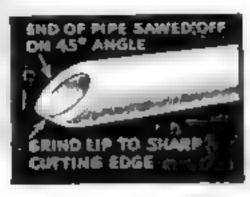
fed slowly into the open chuck for the full depth of the jaws. No more stock should be ground away from the jaws than is absoiutely necessary

A simple steel ring, as illustrated above in Fig. 7, is all that it is necessary to make in order to true up the external set of chuck jaws.

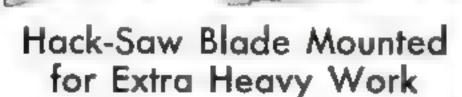
Sharpened Pipe Quickly Cuts Hole in Brick Wall

After each blow the drill is turned slightly

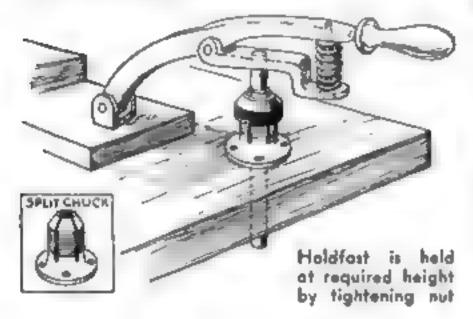




To cut boles through brick walls by hand, a drill can be made by sawing a piece of pipe on a 45-deg, angle, then sharpening it on a grinding wheel or with a flat file as illustrated. Give this pipe drill about one sixth of a turn between each blow of the hammer. This tool has proved superior in endurance to the old-style notched-tooth pipe drill and also more efficient, especially for holes of ½", ¾", and 1" in diameter. That is because the cutting edge is broad and supported by more metal backing



FOR sawing tanks and other heavy materials where a back-saw frame cannot follow the blade, a blade may be attached to an old or cheap handsaw. One end is brazed to the point of the handsaw, and the other end clamped as shown. First, however, the set of the teeth on the handsaw is removed by light hammering or grinding.



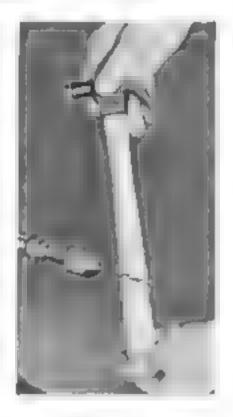
Quick-Acting Holdfast Speeds Bench Work

This quick-acting bench holdfast is adjustable for height and can be swung in a circle. It is held at the required height by tightening the knurled nut on the split chuck. Once set for a certain job, each piece can be clamped down or released in an instant by using the handle to compress the stiff coil spring.—C. H. W.



Leather Gives Good Grip on Hammer Handle

A NARROW leather strip wound spirally around a hammer handle provides a neat, nonslipping grip. The groove can be filed in or made with an old 3, 16° twist drill. Grind shoulders off the sides of the drill to leave a cutting edge and use it as shown. The ends of the leather are held with small wooden wedges. driven holes drilled at either end of the groove.

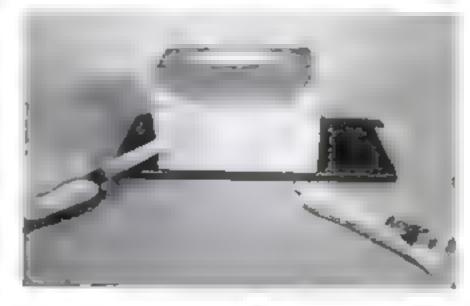




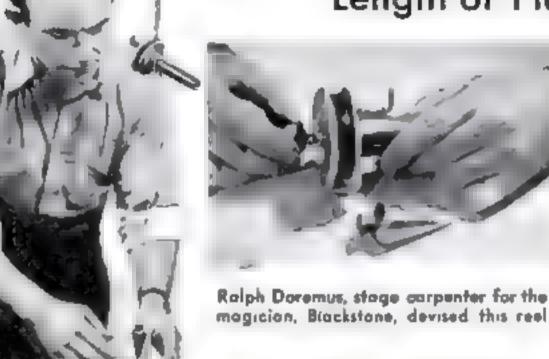


Cold Solder Used for Gluing Up Scratch Pads

ALTHOUGH any good glue can be used in the place of a regular padding compound for making scratch pads from acrap paper, better results can be obtained from the aluminum-colored cement commonly called "cold solder." It dries in five minutes and is water-proof. The pile of paper is squared up all around, a piece of glass or smooth board is laid on top, and a weight of about 5 lb. is placed on top near the edge to be padded. The metallic solder is then applied with a knife to the edge. It dries to a smooth aluminum surface,



Release on Reel Regulates Length of Plumb-Bob Line

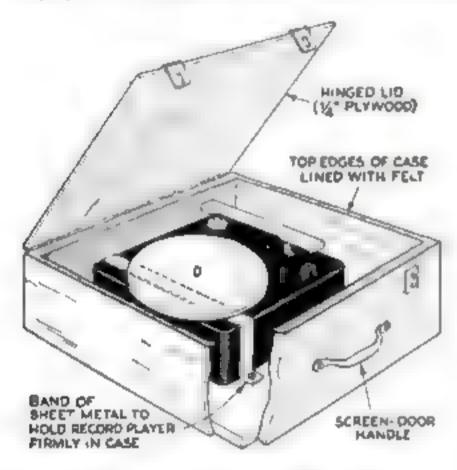


The device, shown in use, may be employed for all kinds of work

WHEN a plumb line is used frequently, this device, which is somewhat like a casting reel, greatly simplifies the lining up of all kinds of work. By working a release with the thumb, the plumb bob is allowed to drop for exactly the required distance.

A length of brass pipe is used for a handle and is boilted to

an aluminum reel made from two disks and a spacer. A winding knob is bolted to one side of the reel, while the edge of the other side is drilled with holes to receive a stop pin. The latter, equipped with a strong spring, is held in a bracket soldered to the handle. Also soldered to the handle is a casting-rod tip with agate guide. If the plumb bob is small enough, it may be stored inside the handle, which may be closed with a cork.



Box Quiets Needle Noise of Record Player

RECORD-PLAYING attachments for use with a radio set are sometimes disappointing because of the objectionable surface noise of the needle. This can be muffled by making a box large enough to hold the player with room to spare for needles, plugs, and accessories. The base and ends may be made of %" white pine, the sides and top of %" plywood. It is important that the joints fit snugly.—Charles Robert Avery.

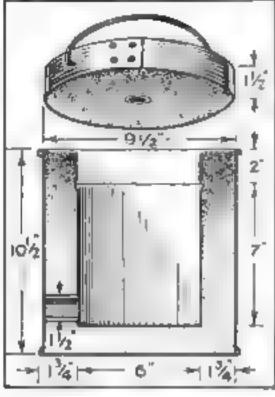


A Model Maker's Plane

Model makers will find this neat littie plane gets right into corners and difficult places. It is made from a block of maple wood, a heavy single-edged razor blade, and a piece of nickel-plated brass. The underedge of the cap is filed off to fit the blade tightly. The blade is adjusted by the screw at the top end of the metal piece.—B. N.







Lifting a crucible of molten metal from the furnace. Left, howthe furnace is constructed

GAS furnace that will hold a No. 7 crucible can be built for about fifty cents exclusive of the burner. In this type of furnace, pewter, britannia metal, bronze, aluminum, and soft pottery glazes can easily be melted.

From a painter obtain a 2½-gal. paint bucket, and from a restaurant a 3-qt. fruit can. Buy a strip of galvanized from 1½" by 35", any gauge from 20 to 30, or get an old strip from a junkman. Obtain 15 lb. of fire clay, some discarded fire brick, and a 3"

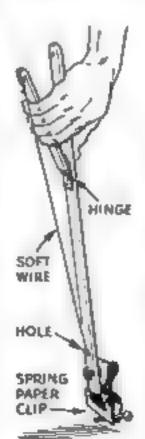
length of 8-gauge wire.

Out of the tin from a can, make one tube 1 1/4" in diameter and 2" long, and a second tube 1" in diameter and 1 1/4" long. Now cut one hole 11/4" in diameter at the bottom of the 3-qt. can and another 11/4" up from the bottom of the paint bucket. These holes are to be connected with the 14" by 2" tube. Pound up fire brick into grog of pea size. Use one-third grog and two-thirds fire clay and make a stiff mixture with water. Tamp a layer 11/4" thick on the bottom of the paint bucket. Set in the fruit can and fit in the tube. Tamp the clay and grog in tightly up to the top of the can, and then finish off the last 2" by pressing the mixture in with the hands.

Make the cover as shown with the strip of iron riveted to form a ring the size of the paint bucket. Set the 1" tube in the center as a gas vent. Ram tightly with clay and grog. When dry, fill in the shrinkage space with fire clay. Punch holes in the opposite sides for the wire handle.

Dry the whole furnace thoroughly for several weeks and then fire slowly with a gently increasing flame for a number of hours, using a standard type of Bunsen burner.

For the burner to use with the furnace, it would be well to consult the local gas representative because the type varies according to the gas available. Ours does equally well with or without additional air pressure. A temperature of 2,000 deg. F. can easily be obtained with the furnace illustrated. Standard pyrometric cones are used in the heats. The furnace should last for a number of years.—R. H. JENKINS.



Pick-Up Retrieves Small Lost Parts

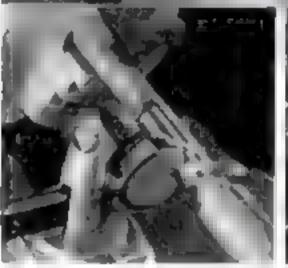
A LIGHTWEIGHT pick-up for small articles that fall on the floor and roll under the workbench can be made as shown from a steel spring clip of the type sold in stationery stores, a short piece of soft wire, a small hinge, and two sticks. The main stick may be any length desired; it is then necessary that the wire be fastened so it is taut when the hinged handle is in an open position and the spring clip closed.—C. H. W.

How to Do Workmanlike Knurling on Small Parts in the Lathe

The knurls are forced in about 1/64" deep, and the tool is fed across the work from right to left

KNURLING adds much to the appearance and usefulness of many small jobs. The knurling rollers in the tool shown are removable and can be replaced by rolls of finer or coarser pitch. In using a tool of this kind, both the work and the rolls should be well oiled.

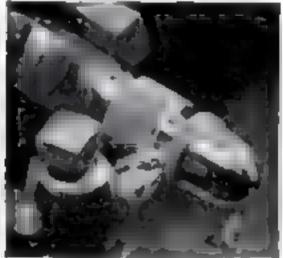
It is best to start the tool on the righthand end of the work. When the knurls have been forced in to a depth of about 1/64", the longitudinal feed of the carriage is set and the tool fed across the face of the work. The knurls can be forced in deeper, the carriage feed reversed, and the operation repeated until the proper depth has been reached. It is advisable to leave the rolls in mesh with the impressions they have made until the work is finished.



Oil must be applied freely because of the pressure used



The impressions are deepened by repeating the knurling operation



When the knurling is finished the part is shaped as required

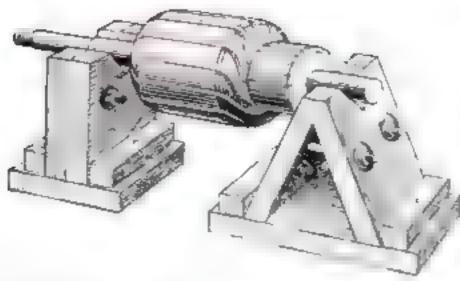
Easy Way to Bore or Enlarge Holes in Porcelain

It is sometimes necessary to enlarge the hole for the water-line connection in an old porcelain flush tank in order to install present-day fittings. This can be done, if a drill press is available, by using a tool turned from brass rod as shown. Carborundum grains (No. 80) and turpentine are fed around the bit during the operation. The actual grinding in this case required about forty minutes, and the

steps of the tool were worn away. If a new hole has to be made in porcelain, use a metal tube for a tool.

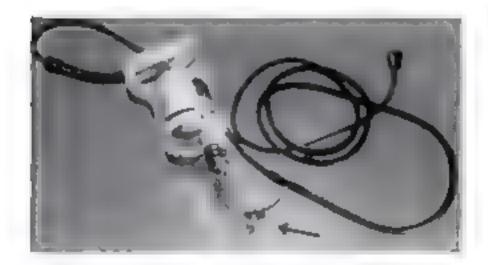
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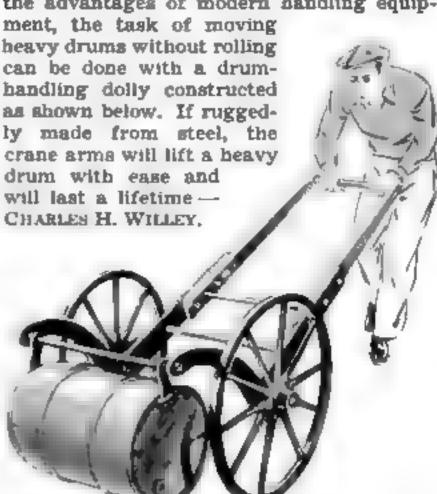
Heavy-Duty Shop Stands of Wood

LIGHTWEIGHT V-stands or plain blocking for shop purposes can be made from any available hardwood. The A-shaped type has a simple but efficient interlocking joint at the upper edge. The inverted-T stand is simpler, but note that the two vertical pieces of plank are arranged with the grain of one crossing the other. In both cases the uprights are strongly bolted together.



Special Carrier Handles Large Steel Drums

IN A small plating plant or the finishing department of a factory that does not have the advantages of modern handling equip-



Fastening a Drill-Chuck Key So It Won't Be Lost

IF THE chuck key is fastened with friction tape some distance back on the electric cord of a portable power drill, as at the left, it will never get lost,—B. K.

SELECTION OF GRINDING WHEELS

[METAL WORKING]

Abrasive—Fused alumina for materials of high tensile strength, silicon carbide for low tensile strength.

Grain size—Fine grain for hard and brittle materials, for small area of contact, and for fine finish; coarse grain for soft, ductile materials, for large area of contact, and for fast cutting. The numbers that designate grain size represent the number of openings per linear inch in the screen used to size the grain: 8 to 10, very coarse; 12 to 24, coarse; 30 to 60, medium; 70 to 120, fine; 150 to 240, very fine; 280 to 600, flour sizes.

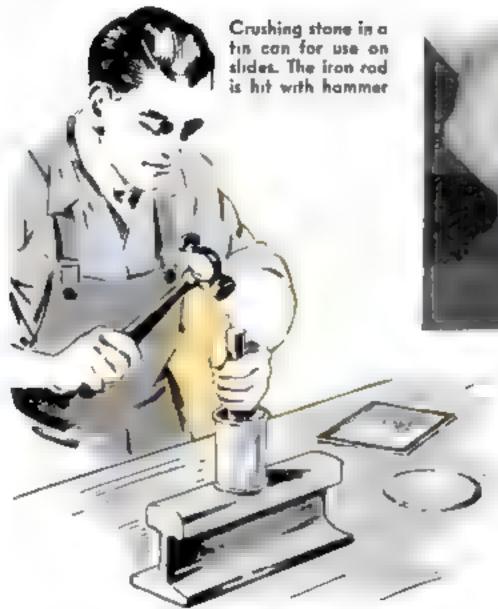
Grade—Hard wheels for soft materials; soft wheels for hard materials. The smaller the area of contact, the harder the wheel should be. Grade is often designated by letters: E to G, very soft, H to K, soft; L to O, medium; P to S, hard, T to Z, very hard.

Structure—Close grain spacing for hard and brittle materials, for small area of contact, and for fine finish; wide grain spacing for soft, ductile materials, for large area of contact, and for rapid removal of stock. Numerals are sometimes used for spacing 0 to 3, close: 4 to 6, medium: 7 to 12, wide.

Bond—Resinoid, rubber, and shellac wheels are best for a high finish. Vitrified can be used for speeds up to 8,500 surface feet per minute; rubber, shellac, or resinoid for speeds above that.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Secrets in Stone Revealed



HE lowliest pebble in your garden may prove to be a fairyland of color and gemlike shapes, if you subject it to the scrutiny of your magic lenses. Microscopic study of rocks is a highly important activity of science. Petrographers—scientists who work with rocks—would be lost without the microscope. Although there are rock materials whose structure can be deter-

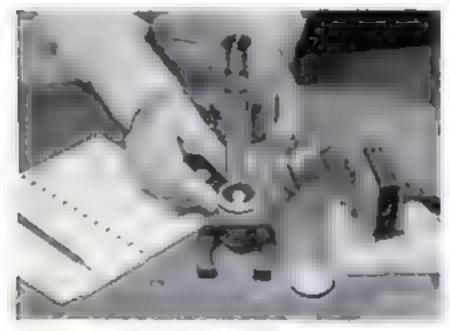


After sifting through a screen, the crushed stone is scattered on balsam-coated slides

mined sufficiently with an ordinary magnifying glass, there are many whose structure is too fine to be studied except at high magnifications.

Although you probably do not have the specialized equipment of the petrographer, you can nevertheless spend many enjoyable hours exploring the mysteries of pebbles, stones,

bowlders—and whole mountain peaks if you want to. To get your material, all you need do is scout around a bit outdoors, pick up some pebbles or knock some chunks out of larger rocks with a hammer, and take them back to your laboratory. On your collecting expedition, try to get a sample or two of limestone (perhaps from a driveway), and some speciment of other kinds of rock



A piece of rock mounted in a pill box for examination. Inside of the box is pointed black



The first step in grinding down a specimen is to heat balsom for comenting rock to a slide

by Your Microscope

By MORTON C. WALLING

that contain glittering, glasslike particles.

With a hammer and a large rock on which to rest the smaller pieces, break them into still smaller fragments, say less than 1/2" in their longest dimension. Pick out the thin, flat ones, and lay them aside for later preparation.

Pick out a fair-size chunk of the rock you are studying, and mount it so you can examine its surface with your microscope. There are two principal ways of making such permanent mounts. One is to place the piece in a deep cell on a slide, and the other is to mount it in a small, round pill box.

You can buy little glass rings or squares of various sizes that can be cemented to an ordinary slide with balsam. These are a bit expensive. A much cheaper way is to build up circular or square cells from strips of cardboard and then render them moisture-proof by saturating them with shellac, lacquer, or varnish. Still another way is to bore a hole, say 5," in diameter, in a strip or block of wood, or in a block made by gluing several layers of cardboard together.

Whatever the cell material, the inside dimensions should be such that a standard cover glass will fit over it. The depth should be sufficient to hold the specimen, say 5 to 10 mm. Paint the inside of the cell black, and use a layer of black paper over the glass at the bottom. The piece of rock is fastened, with balsam or with quick-drying pyroxylin



A section of rock as viewed by polarized light

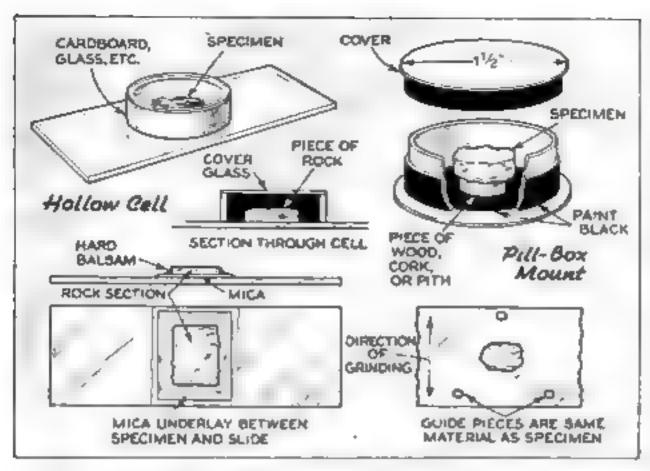
cement, to the bottom of the cell or to a littic support of cork, pith, or wood. Just before cementing the cover glass in place, heat the slide, cell, and specimen gently, to drive out moisture. A cover glass is not absolutely necessary, but will serve to keep the



Attaching the piece of stone to a sheet of mica on the slide to grind the first side



Stone sections are ground on a wet abrasive stone. The hardest part is to keep the slide flat and avoid producing a convex surface



Data'ls of call mounting, pill-box mounting, and grinding rock sections

The second way of mounting small pieces of rock is to cement them to supports of cord, pith, or wood which in turn are fastened to the bottoms of small, rounded pill boxes like that shown. Square boxes will do just as well as round ones. Paint the inside of each box black with India ink or dull less

specimen clean and protect it from barm.

boxes like that shown. Square boxes will do just as well as round ones. Paint the inside of each box black with India ink or dull lacquer. The lid provides sufficient protection against dirt and damage, so a cover glass is not needed. Since the microscope is used at

low power for examining such specimens, the pill boxes can be set on the stage without trouble.

Slides of crushed rock make interesting specimena for microscope examination, and some of are particularly beautiful in polarized light. Crush the rock with a hammer, and sift it through a fine-mesh screen to remove large chunks. Mount the particles in a single layer on a standard slide, either in a shallow cell or without any such protection. To make the particles adhere to the glass, coat the center of the slide with a thin layer of bai-

sam. Distribute the crushed stone over the balsam, and set the slide aside for a day or two. Jar off all unanchored particles, and if the specimen is to be covered, apply the cover glass. A quicker way is to heat the balsam gently to drive out some of the solvent, after it has been spread on the slide, and drop the particles on it immediately. When the balsam cools it will be hard

The making of thin sections of rock is considerably (Continued on page 246)

Weights Hold Cover Glasses Down

IN MOUNTING microscope specimens permanently in balsam on 1" by 3" slides, it often becomes a problem to hold the cover glasses down firmly while the bal-

The weights used here are old muzzle-loader bullets

sam sets. Various clamps and other gadgets have been devised for doing this, but one of the simplest stunts is as follows:

Obtain an assortment of lead weights in the form of short cylinders 😘" to 5," in diameter. Be sure that one end at least is perfectly flat and square with the sides, so the cylinder will stand upright. There should be several lengths, to give a variety of weights ranging from about 1/2 oz. to 2 or 3 oz. When the cover glass has been applied, lay the slide on a perfectly level surface and carefully set a weight in the center, using a light weight for delicate specimens like diatoms or insect parts, and a heavier weight for more rugged subjects such as rock sections. Weights shown in the illustration at the left were made originally as bullets for muzzle-loading guns.

Table-Top Oil Refinery

FOR THE HOME CHEMIST

By RAYMOND B. WAILES

Armies Make Oil Supply Vital," "Shortage of Fats Imperils Nation at War"—headlines like these spotlight what used to be routine items in a country's shopping list, and give them new interest for home-laboratory experimenters.

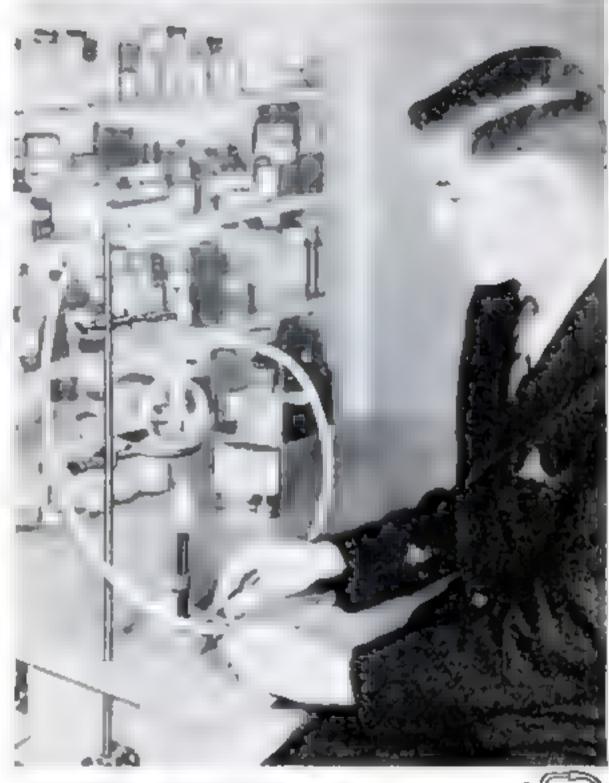
Envious eyes the world over turn toward our vast forests of oil derricks, and the rivers of crude oil that refineries turn into gasoline for vehicles of war and peace. What makes their enormous production possible is the modern "cracking" process for extracting gasoline. Once the crude oil was simply distilled to sepsrate, in turn, the gasoline and other substances it contained. Today, in addition. by-products of the distillation are "cracked" or broken down into gasoline, doubling the total yield.

You can demonstrate for yourself how this is done, with a miniature cracking unit. Its furnace may be a

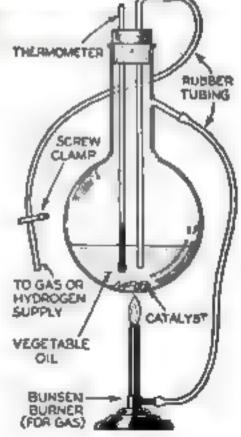
test tube, preferably of heat-resisting glass. Fit the test tube with a one-hole stopper, and connect it with a small flask or a side-necked test tube. This second vessel catches the condensate from the cracking reaction. Finally, the condenser should be fitted with a straight glass delivery tube so that "refinery gas" formed in the reaction will issue from it and can be burned.

White mineral oil, the ordinary medicinal kind that you can buy at the corner drug store, will serve as your raw material. Place about five cubic centimeters (a teaspoonful and a half) of the oil in the first test tube. Fill the space in the tube above the oil with a wad of steel wool, to obtain a greater cracking area. Keeping the top of the test tube hot will heat the steel wool in turn, and oil vapors coming in contact with the hot material will crack, or decompose.

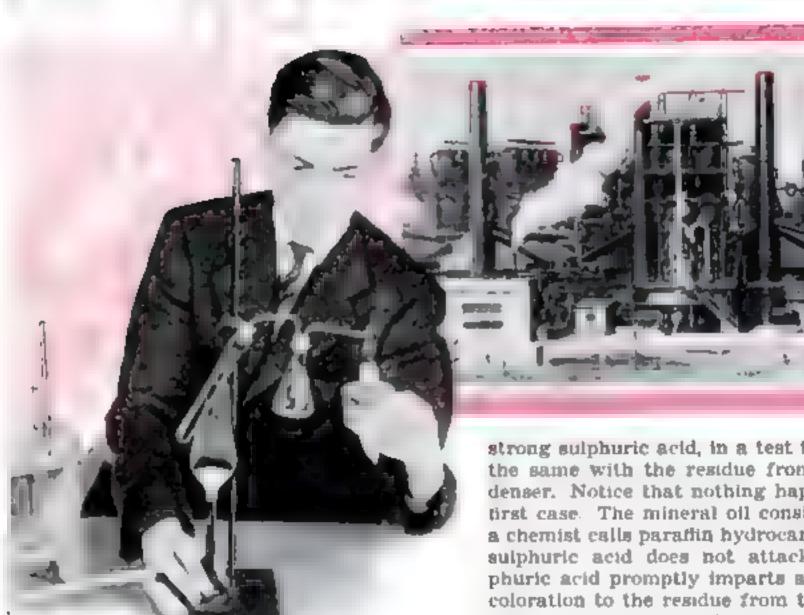
Start the experiment by slowly applying the flame of a Bunsen



Converting a liquid oil into a solid fat, by the process used in making vegetable shortening. The apparatus is shown below THERMOMETER



In the simple experiment illustrated at the lower left, you can duplicate the process employed in great industrial plants in "cracking" oils for petroleum products



burner, fitted with a flame-spreading attachment, so as to heat the oil and the steel wool simultaneously. The oil will soon reach its boiling point. As the oil vapors pass through the hot steel wool, they break down into a number of lighter petroleum "fractions" or products, including gasoline and also combustible gas. You can light the gas at the end of the delivery tube.

When all the oil in the first test tube has been vaporized, let the apparatus cool. You will find an oily product in the flask or sidenecked test tube that has served as a condenser. Its odor alone will tell you that

something has happened to the mineral oil that you started with, and a simple experiment will confirm this.

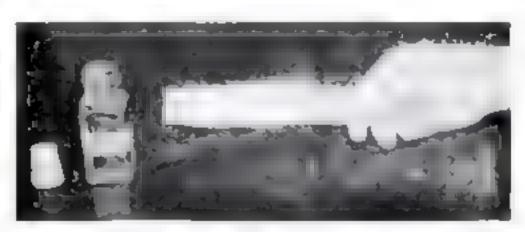
Gently shake a teaspoonful of mineral oil with an equal quantity of

> Linoleum in the making: a strip of cloth an which linseed oil has been allowed to axidize. Already it is stiff enough to be held horizontally

strong sulphuric acid, in a test tube, and do
the same with the residue from your condenser. Notice that nothing happens in the
tirst case. The mineral oil consists of what
a chemist calls paraffin hydrocarbons, which
sulphuric acid does not attack. But suiphuric acid promptly imparts a brown discoloration to the residue from the cracking
experiment, showing the presence of "olefines" or "unsaturated hydrocarbons" such
as are found in natural petroleum. In other
words, you have changed back a refined
product into one more akin to crude oil.

In commercial practice, this cracked oil is redistilled to separate the gasoline, kerosene, gas oil, and other "fractions" of which it is a mixture. Of course, pure white mineral oil is not the commercial raw material, but it illustrates the cracking principle nicely.

Instead of breaking down molecules of oil, you can build them up, by the method known as "hydrogenation." This is the process used to produce well-known brands of lardlike shortening fats, glistening snowywhite solids, from liquid vegetable oils such



EXPERIMENTS WITH OILS AND FATS REPRODUCE

as cottonseed oil. Chemically, it consists simply of adding hydrogen to the original molecules.

That isn't quite as easy as it sounds, however, unless you know the trick. You must have the aid of a catalyst, one of those curlous agents that promote reactions without undergoing any change themselves. In this case you can prepare your own catalyst.

 IRST, add a solution of sodium hydroxide or of potassium hydroxide to a solution of some nickel chemical—nickel sulphate, nickel nitrate, or nickel chloride, for example. The strengths of the solutions do not matter, Mixing them will yield a light-green precipitate of nickel hydroxide. Let it settle, and then pour off the clear liquid above it. Add fresh water; shake well; let the precipitate settle; and pour off the clear liquid again. Repeat this "washing by decantation" several times, to free the nickel hydroxide from other chemicals. Then filter out the precipitate and dry it. Place the dried product in a Rose's crucible, or in an eight-inch length of glass tubing with an inside diameter of about half an inch. Pass hydrogen gas over the nickel hydroxide while you heat the outside of the tube or crucible. The hydrogen reduces the nickel hydroxide to metallic nickel. This reduction should be carried out at a temperature a little below red heat, and allowed to proceed for about fifteen minutes. The hydrogen may be supplied from a simple acid-metal generator, or illuminating gas, which contains free hydrogen, may be used. In either case, the gas that has passed over the contents of the tube or crucible should be led away and discharged outdoors.

When your homemade nickel catalyst is ready, place it in a distilling flask and add one or two fluid ounces of a vegetable oil, such as cottonseed oil or salad oil. Cork the flask with a two-hole stopper. Through one

hole, a chemical thermometer should dip into the oil. The other hole carries a glass tube, also dipping into the oil, through which hydrogen gas can be delivered.

Heat the oil to about 175 or 200 degrees centigrade (350 or 375 degrees Fahrenheit) and keep it at this temperature while hydrogen gas bubbles through the oil for about twenty minutes. Here, again, ordinary illuminating gas may be aubstituted for hydrogen. If you use illuminating gas, you can lead the excess gas from the exit tube of the distilling flask to a Bunsen burner, and use it to heat the flask-just as byproducts are put to use in industrial processes. But if pure hydrogen gas is used, do not try to burn it. There would be danger that the flame would "strike back" into the flask, and explode any hydrogen-air mixture that might be there. Out the window, through rubber tubing, is the best way to dispose of the left-over hydrogen.

After this twenty-minute treatment of the oil, turn off the gas supply and let the flask cool. If all has (Continued on page \$45)

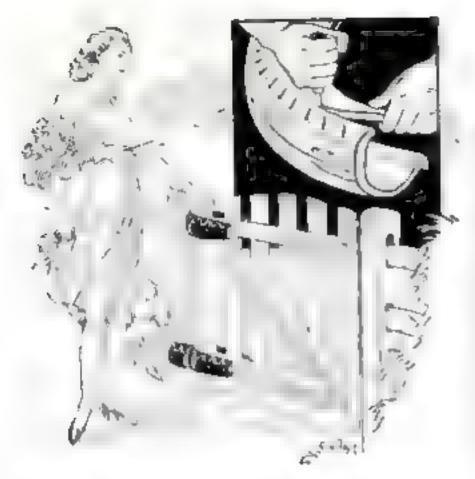


Hydroquinane, added to a vegetable oil used as a heating bath, will keep the oil from becoming roneid. Left, making a rubber substitute by heating sulphur and linseed oil



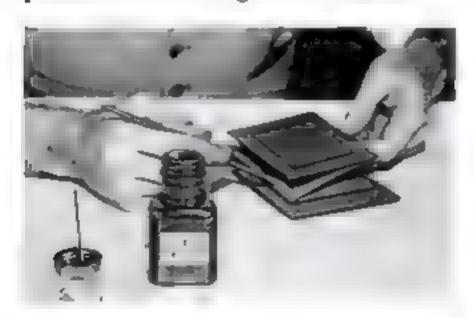
IMPORTANT PROCESSES USED IN INDUSTRY .

FEBRUARY, 1940 211



Sections of Old Auto Tires Keep Gate Closed

GATES of the type shown above can be fastened securely for all ordinary purposes by placing sections of old tires opposite each other on gate and gatepost. The sections should fit snugly against each other and be painted to match the gate.—E. REYNER.

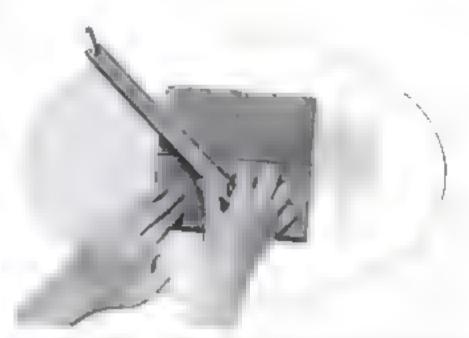


Thin Bicycle-Rim Cement Repairs Many Articles

A CEMENT that will adhere to metals and other materials and will not become brittle upon aging may be made from an asphaltic-base, bicycle-rim cement resembling tar, which may be found in most hardware stores. It should be thinned with cigarette-lighter fluid, high-test gasoline, or carbon tetrachloride, then brushed on both surfaces and allowed to dry for a minute before the parts are pressed together. This cement is particularly useful for repair work on camera bellows, focal-plane shutters, and coverings.—Armistead Wharton.

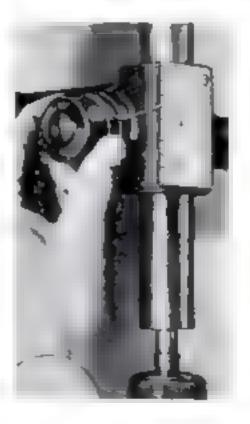
Improvised Ellipsograph Draws Perfect Ovals

FOR drawing perfect ovals, a substitute for a draftsman's trammel or ellipsograph can be made as shown below. The arm is a straight stick with a hole in one end for the pencil. At the other end two nails are driven through the wood so the points project slightly. The distance between the nails represents the difference between the required length of the oval and its width. The base is a square piece of wood about ¼ " thick and a little larger than twice the distance between the nails. Two grooves about %" deep are cut through the middle of it at right angles to each other. By sliding each of the nails completely back and forth in its individual groove, the oval may be drawn.—CHARLES J. LONG.



The projecting nail points slide back and forth in the two groaves while the pencil moves around

An Accurate Depth Gauge for the Drill Press



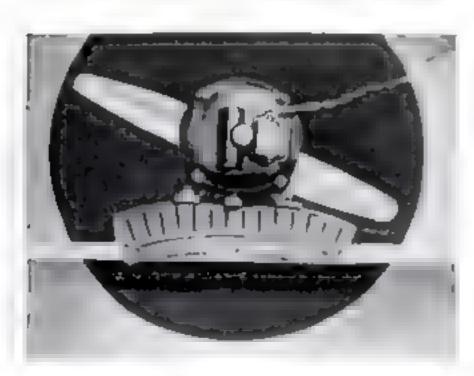
TO MAKE a simple yet accurate depth gauge for the drill press, bend a pointer of plane wire, about 0.035" in diameter, for a spring fit around the pinion shaft as shown. Attach a 16-gauge aluminum plate to the front of the press so that the wire travels along one vertical edge. Graduate the plate to represent sixteenths of an inch.

Getting Longer Service from Scroll-Saw Blades

EXTREMELY fine scroll-saw blades, such as are necessary for cutting jig-saw puzzles, are not essential for many other types of fine cutting, and, indeed, are not desirable because they break so readily. For example, I get excellent results by using medium blades such as Nos. 4 and 5 in cutting the small animals and birds I have described in articles in POPULAR SCIENCE MONTHLY. They cut faster than the smaller blades, make wide turns easily, and seldom break.

When V-shape cuts have to be made, I cut the general outline of the design first, omitting the indentations, and then cut each V with two converging cuts as in Fig. 1. If a sharp projection is required, I cut beyond the point, as in Fig. 2, then make an easy turn and come back along the other side of the angle. When two or more pieces are to have an opening through them and are to be glued together afterward, I cut through them as in Fig. 3, then glue them together so that the cuts do not come one above the other. If, however, an opening is to be cut in a single piece of wood, I first drill a bole for inserting the saw blade in the usual way, as shown in Fig. 4

Most of my work, being very small, is done on a high-speed magnetic saw which, however, has no adjustment to change to a new cutting area on the pin blades when the teeth actually being used have become dull. If the work is not too delicate, I slip a piece



Old Tire Casing Reduces Vibration of Motor

To LESSEN vibration and noise from a cooler fan, a section of tire casing was cut with a rip saw and four holes were drilled for bolting the motor to it. The side walls of the casing were then nailed to the edges of a board as shown above.—R. L. BAKER.

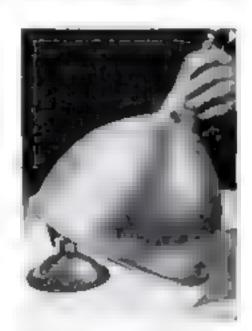


of wood under it as soon as the blade has become duil and finish the cutting on an unused section, thus getting considerably longer use. The supporting block has, of course, to be alld around so that the saw does not cut into it.—EDWARD B. FOX.

Reflector Acts as Oven for Baking Enamel

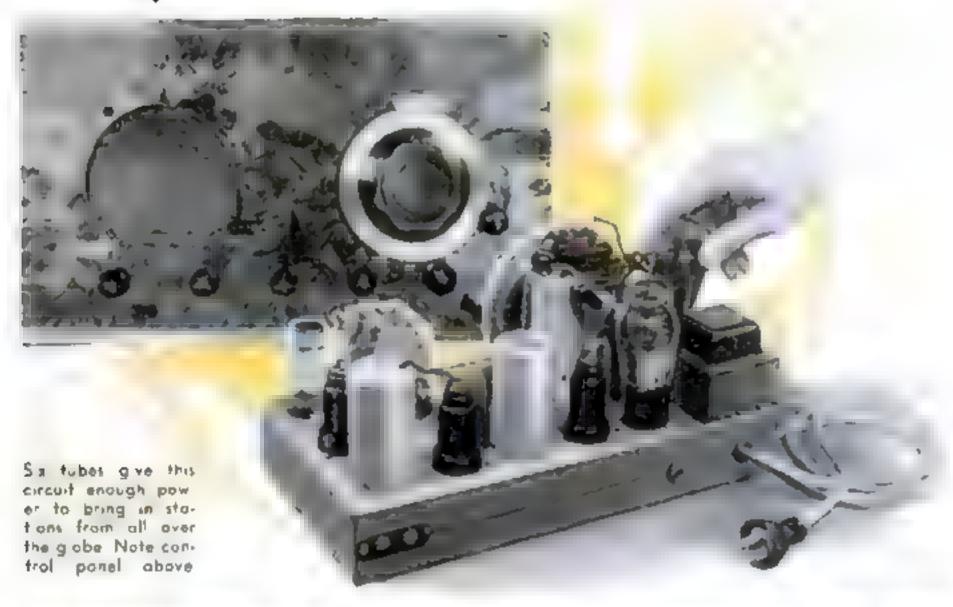
A LARGE reflector, such as is often used in making photographs indoors, can be converted into a small but efficient oven for

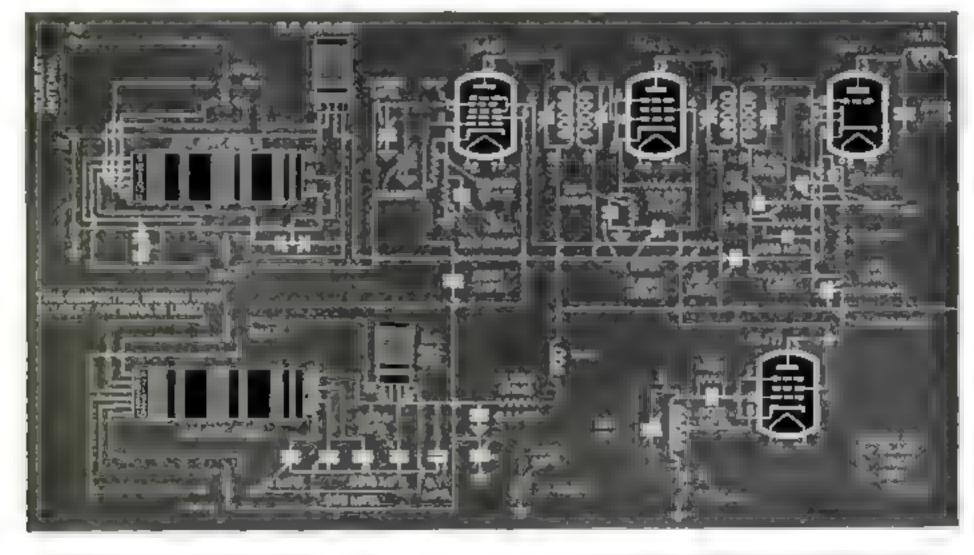
articles that are to have a bakedenamel finish. Insert & 60-watt, or larger, lamp bulb the reflector. then invert it over the enameled article. The temperature can be increased, when necessary, by covering the reflector with an old blanket to insulate it from the Placing the object on top of sheet metal will also increase the heat within.



Placing an electric lamp in a reflector over a small metal object in order to bake on a coat of special crackle-finish lacquer

hround-the-World





Receiver costs \$20 to BUILD

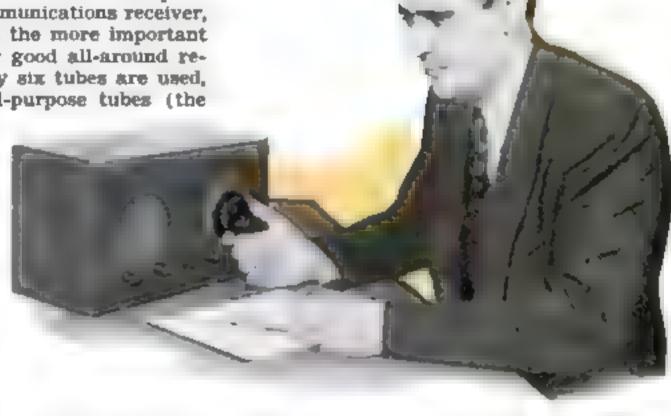
By ARTHUR C. MILLER

WENTY DOLLARS will build this powerful six-tube communications receiver, which includes all the more important features necessary for good all-around reception. Although only six tubes are used, two of these are dual-purpose tubes (the

6A8 which acts as a combined first detector and oscillator, and the 6Q7 which serves as the second detector and first audio amplifier) resulting in eight-tube performance. This set has plenty of power to bring in short-wave stations from any part of the globe.

The circuit covers the entire range from twelve meters up to

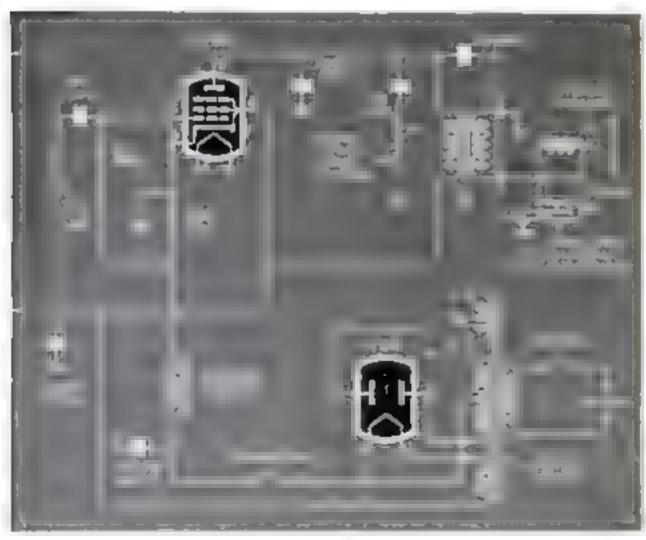
550 meters. This range is divided into four bands (550 to 200 meters, 200 to 75 meters, 75 to 35 meters, 35 to 12 meters) by means of a selector-type switch which is noiseless in operation. Among its other features are a sensitive, self-contained dynamic speaker, a stand-by switch, a beat-frequency oscil-

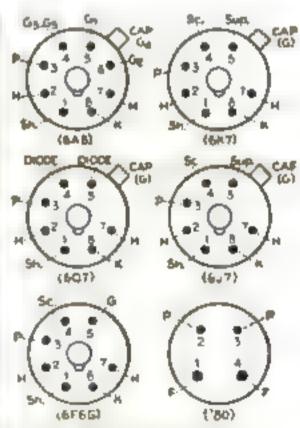


The set includes many of the autstanding features of the latest models

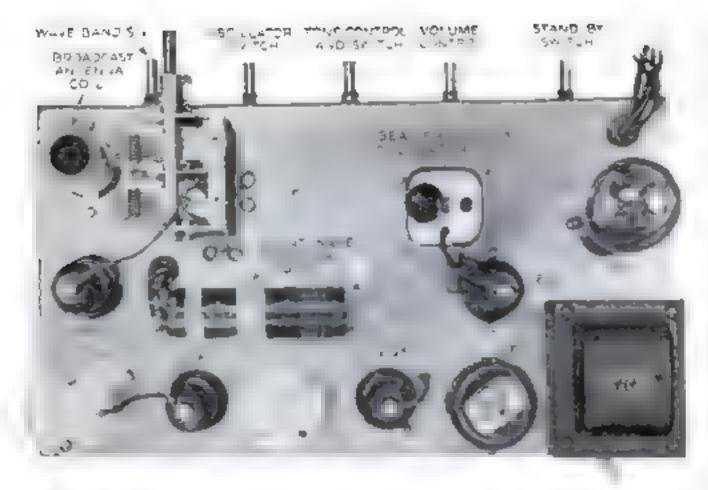
lator with pitch control and on-off switch, automatic volume control, a full-range tone control, and provisions for the use of either a doublet or L-type antenna.

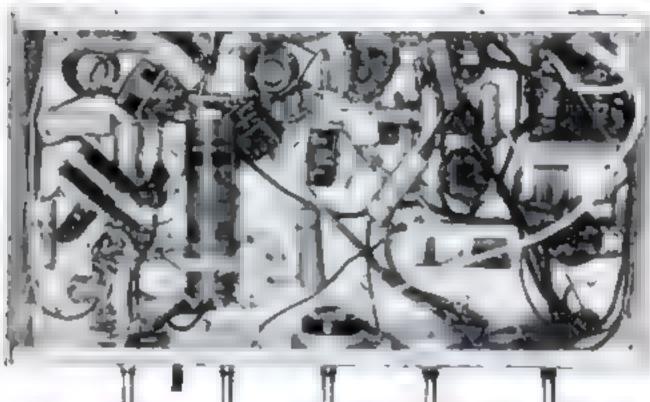
No band apread has been used in the original design as satisfactory results were obtained by the small friction-drive vernier





COMPLETE WIRING DATA for the circuit and the tubes are given in the diagrams at the left and above. A supersensitive band spread is shown in datted lines





dial shown next to the outer rim of the large tuning dial. Most readers will find this system sufficient for their needs, especially as this vernier control costs only ten cents! However, those who wish to add an electrical band-spread system may do so. It involves only a slight additional cost of from one to two dollars, and consists merely of wiring a two-gang tuning condenser having a very low maximum capacity (approximately fifteen micromicrofarada) across the main two-gang tuning condenser as shown by dotted lines in the diagram. It can be mounted between the speaker and main tuning control. This avatem is used only for the short-wave bands and becomes inoperative on the broadcast band.

All-metal tubes are used in all stages but the last. In this stage (the output or second audio amplifier) an

PARTS FOR THE COMMUNICATIONS RECEIVER

All-wave coil kit. Two-gang tuning condenser, 15 mmfd Two-gang tuning condenser, 15 mmfd (see text). Beat-frequency coil. One 4-prong and five octal wafer sockets. Tone control, 50,000 ohm; and switch. Volume control, 500,000 chm. S P.S.T. rotary stand-by switch rive-inch dynamic speaker, 3,750 onm. Power transformer. Two radio-frequency chokes, 2.5 mh. Padder condenser, 3-30 mmfd. Two carbon resistors, 1/2 meg., 1/2 watt. Carbon resistor, 1 meg., 1/2 watt. Carbon resistor, 250,000 ohm, 1/2 watt. Carbon resistor, 200,000 ohm, % watt. Carbon resistor, 100,000 ohm, % watt. Carbon resistor, 50,000 ohm, % watt. Carbon resistor, 25,000 ohm, % watt. Carbon resistor, 25,000 ohm, 1 watt. Carbon resistor, 10,000 ohm, % watt. Carbon resistor, 15,000 ohm, 1 watt. Carbon resistor, 8,000 ohm, % watt. Carbon resistor, 500 ohm, % watt.

Carbon resistor, 400 ohm, 1 watt. Carbon resistor, 300 ohm, 1/4 watt. Carbon resistor, 200 ohm. % watt. Five tubular condensers, .1 mfd., 400 volts. Five tubular condensers, .05 mfd., 400 voits. Tubular condenser, .01 mfd., 400 voits. Three mica condensers, .0006 mfd. Three mica condensers, .0001 mfd. i wo electrolytic condensers, 12 mfd., 450 volts. Electrolytic condenser, 10 mfd., 25 volts. Mica condensers, .003 mfd., and .0016 mfd. (included in coil kit). Converter tube, 6A& Amplifier tube, 6K7. Amplifier tube, 6J7. Detector-amplifier tube, 6Q7. Power-amplifier tube, 6F6G. Rectifier tube, 80. Dial, 4-inch, with vernier attachment. Vernier dial, 3-inch (see text). Miscellaneous: Five dial knobs; aluminum panel and chassis, phone jack; wire.

octal glass tube is used. The same thing applies to the 80, or rectifier, tube.

The purpose of the beat-frequency oscillator is to introduce oscillation into the intermediate-frequency stage so that when tuning to weak or distant stations they will not be missed. With this oscillator in operation, a slight whistle is heard each time a station is passed, much the same as that heard when tuning a one or two-tube receiver with the regeneration control full on.

Another helpful feature is the stand-by

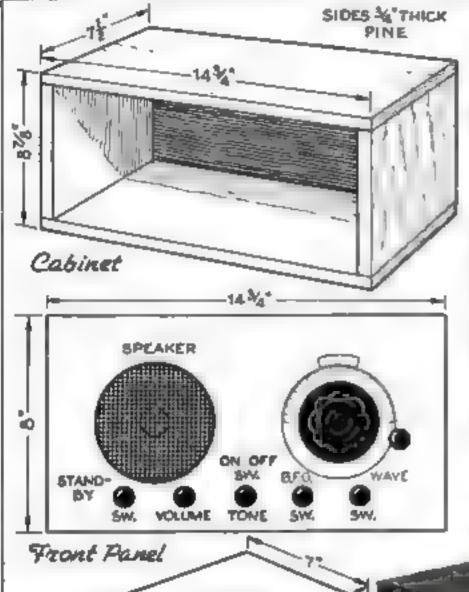
switch. This control cuts out the plate and screen voltages and silences the set but does not disconnect the heaters of the tubes so that the set can be switched back into immediate operation without any waiting for the tubes to heat up.

The intermediate-frequency transformers are of the tuned-grid, tuned-plate type, and are adjusted to the proper frequency before leaving the factory. This adjustment allows for normal stray capacities found in the average receiver, and, unless excessive capa-

> cities are introduced such as grid-wire shielding, only a slight touch of the trimmers is necessary to align the intermediate-frequency amplifier. However, an oscillator should be used to align the set on the short waves. This will be done for a nominal sum by your local radio service man.

> The cabinet for this set should not cost more than fifty cents and is easily built at home. It is made of white pine three quarters of an inch thick and consists of only four sides, with no front or back. As the aluminum panel everlaps the chassis in length, it will prevent the chassis from sliding in too far, and at the same time provides a means of anchoring the whole set firmly in the cabinet by means of screws at each end of the aluminum panel. The back of the cabinet is left open to provide adequate ventilation for the tubes.

> To give a dressler appearance to the control panel, apply a coat of brown, crackle-finish lacquer,



Aluminum Chassis

Cabinet, panel, and chassis dimensions and arrangement of controls should be followed closely

> The back of the cobinet is left open for ventilation. The chassis is slipped in and held in place by screws

SIX NEW HELPS

Volume-Control Replacement Kit

MATERIALS for replacing any part or all parts of the volume-control unit of more than 400 different makes of radio receivers are contained in the bandy kit at the right. Not only are variable resistors of various sizes and values included, but also assorted shafts, adapters, and couplings to fit practically every radio made.



With this lift you can repair the volume control in any receiver

New Radio-Tube Tester Works Automatically

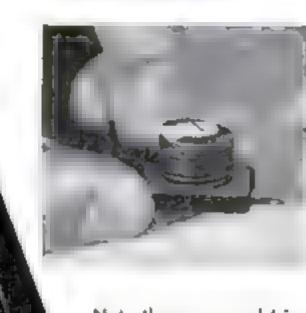
With a built-in filing-card index, a new tester automatically adjusts itself to show the condition of any receiver tube. After a perforated card is placed in a slot, the tube is placed in the testing socket and a lever is pulled. This causes electrical contacts to be

made through the card's perforations and the tube s condition is registered on a directreading meter. The card to be used depends on the type of tube to be tested.

Tiny Air-Spaced Trimmer Condenser

EMPLOYING a novel principle of construction, a tiny air-spaced trimmer condenser of British design measures only 1" by %" at its base. Both the moving and fixed vanes are cut in the form of a continuous spiral. The fixed spiral is per-

manently fastened around a composition center post. The moving spiral screws into the fixed one on a thread cut into the center post that prevents the vanes from coming in contact with one another. Thus, when an adjusting screw at one end of the movable spiral is turned, the capacity of the condenser is altered. At its minimum capacity, the idle portion of the moving vane compresses to save space.



Note the air-spaced trimmer condenser's small size. Sketch shows how it works

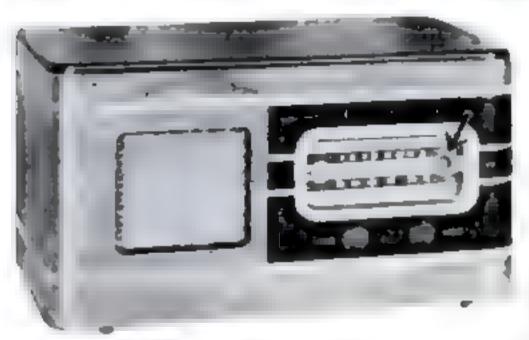
FOR RADIO FANS

Matched Units for Radio and Phonograph

INSTEAD of being built as a single unit, a new two-unit radio-phonograph combination does additional duty as a pair of end tables for a sofa. In one table is an allwave receiver. In the other is a record-playing unit that literally broadcasts by radio the records it plays to the receiver in the other table. or to any other set located in the same room or elsewhere in the house.



The end table at left holds a radio; at right, a wireless record player



Blinker Light Shows If Battery Set Is On

REQUIRING so little current that it would take 230 years to consume the total power stored in the batteries of a portable radio in which it is used, a neon-type pilot light that shows when the radio is turned on is a feature of a new battery-operated set. Besides serving as a telltale, the "blinker" also shows when the battery voltage drops below the minimum required for its operation.

Radio-Test Laboratory on Wheels

For testing the quality and intensity of its transmitters' signals in various regions, the Columbia Broadcasting System has equipped the sedan shown at the right with special

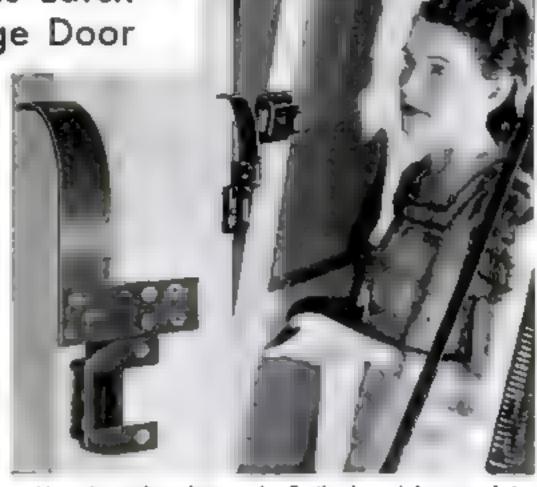
apparatus that permits its engineers to make quick check-ups at any point that can be reached by car. The two finlike plates on the roof are "compensators." Their purpose is to counteract any effect of the all-metal body on radio signals reaching the antennas: one a loop for broadcast reception, the other a dipole for ultrahigh-frequency reception.



Hints for Car Owners

Striker Plate Adapts Latch to Overhead Garage Door

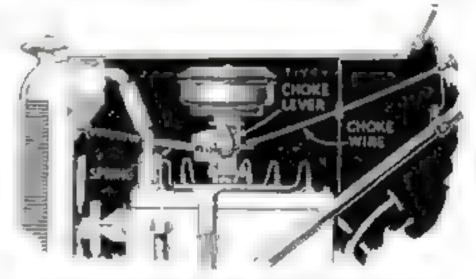
A REGULATION door latch may be adapted for use on an overheadtype garage door by the simple expedient pictured in the photographs at the right. The metal section of the lock into which the latch bolt fits is fastened to the door jamb, and above this an easily made, curved striker plate shaped from 1½" by ¼" steel is installed endwise, as pictured. The latch case is then positioned on the door itself. As the door descends, the latch will contact the edge of the steel striker and be forced inward to clear the top side of the metal receptacle into which it slides. When the door has been pulled down all the way. the latch bolt is then free to slide into place as on an ordinary swinging door.-W. O. W.



How the striker plate works. Easily shaped from steel, it depresses the latch as the overhead garage door is lowered

Choke-Rod Return Spring Aids Forgetful Drivers

IF You find that you sometimes run your car with the choke button partially out, forgetting to push it in after a cold-weather start, try attaching a spiral spring between the carburetor choke arm and a convenient spot on the radiator shell. Then adjust the spring tension so that the car vibration will joggle the spring and cause it to reopen the choke.—C. R. H.



Spring tension returns the choke if you forget it

Garage-Wall Mark Shows Backing Limit



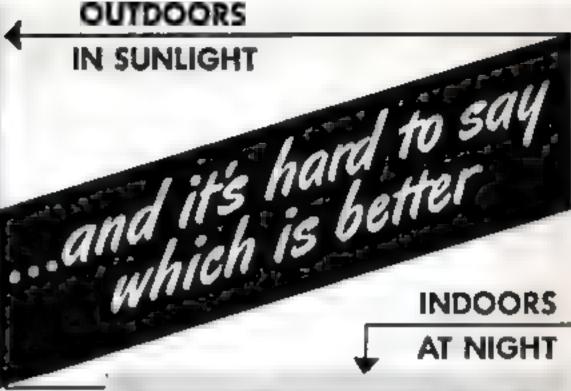
The line shows the driver he has backed for enough

BECAUSE I use the extra space in the rear of my garage for storing things, I have to know exactly where to stop my car when I back it in. A few rear-end bumps convinced me that I could not trust my sense of dis-

tance, so, with the car in the right position, I painted a vertical line on the side wall of the garage opposite my head as I sat in the driver's seat. Now I back the car in with confidence, knowing that I have only to stop when my head comes even with the line.—

L H





NIGHT SNAPSHOTS SIMPLE AS A-B-C with KODAK SUPER-XX FILM

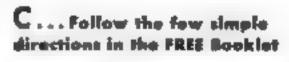
EVEN in the hands of a beginner, Kodak Super-XX Film, four times as fast as ordinary film, gets excellent indoor snapshots under Photoflood lamps. The pictures come out every bit as good as though they had been taken outdoors under a

summer sun. To give outdoor excellence to your indoor snapshots, use Kodak Super-XX always. (You don't need an expensive camera to make snapshots indoors after dark; you can use any one at all that takes Super-XX, even a \$1 Brownie.)





B... Use a couple of inexpensive Mazda Photoflood Jamps in Kodak Handy Reflectors



A few minutes with this helpful booklet and you're headed for splandid nighttime snapshots. Photos, diagrams, easy-to-understand directions. At your dealer's . . . Eastman Kadak Company, Rochester, N. Y.



Are you a "hobbyist," model maker, or master of a metal-working trade? Then you're one who recognizes the absolute need of good tools to do good work. There's little difference between the cost of hit-or-miss-quality files and Nicholson (or Black Diamond) Files. But there's a world of difference in results—and satisfaction?

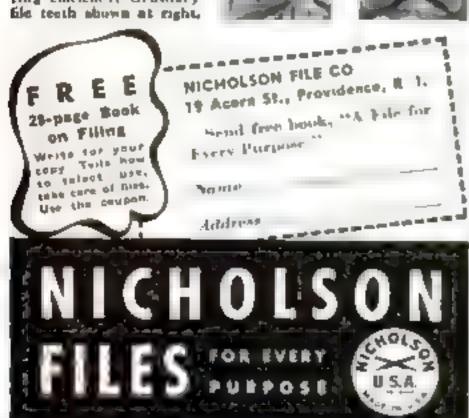
Push a Nicholson double-cut flat file across a piece of metal that needs a lot of stock removal, and see it bits in like a hungry pup's fangs whitting down a bone. See, too, how it holds to the line like a keen-edged skate-runner! All due to exclusive (patented) acreated tooth construction*—and to Nicholson's tough hardness and other superfine qualities! Or, lay a Nicholson single-cut mill hile onto a piece of precision work and note its sweet-cutting performance!

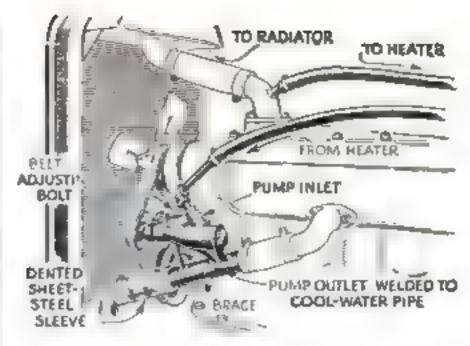
A popular work-bench assortment of Nicholson or Black Diamond Files will prove a prized possession. Your hardware dealer can supply you.

"Special-type aerrations (left) give Nicholson and Black Dumand File teeth successive new culting edges—assoring longer cutting efficiency. Orderary file teeth shown at right,









Hot-Water-Heater System Uses Separate Pump

IN SOME cars having a thermosiphon water-cooling system, a hot-water heater can be made to work by installing a water pump as shown above. I purchased a second-hand automobile water pump, removed the outlet and intake extensions, and welded the outlet pipe to the car-radiator intake pipe. A small nipple was then welded to the pump intake and the hose from the car heater attached. A supporting piece of iron was next welded between the pump and the cold-water pipe for the sake of rigidity. and a V-type pulley substituted for the flattype on the pump, over which the fan belt runs to drive the pump shaft. To increase efficiency, a thermostat was placed in the upper radiator-hose connection.-L. J. L.



Strips of Rubber Plug Holes in Tire Casings

NAIL holes in a tire casing can be sealed with a strip of inner-tube rubber cut thin at the center and wider than the hole at the ends. Sanded and then saturated with rubber cement, the strip is pulled through the hole with a loop of thin wire, stretching it into place. Trim the projecting ends, and place a patch over the inside.—A. H. V.



Whatever the Job. These Features Help You Do It Easier and Better!

You buy a lathe with definite things in mind: Precision workmanship—simple, convenient operation and complete versathity dependable, long-life construction. And price is usually important. In all these respects you il find experienced machinists advising— "Get the modern Atlas," Here are some of the reasons why:

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Sensible Prices. The 10" horizontal countershaft model above is \$104.75 complete as shown less motor—with vertical (attached) countershaft only \$99.75.

Whatever the job, you can do it easier and better with an Atlas Lathe. See them at your dealer's or send coupon below for 1940 Catalog.



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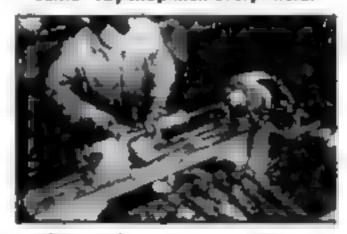
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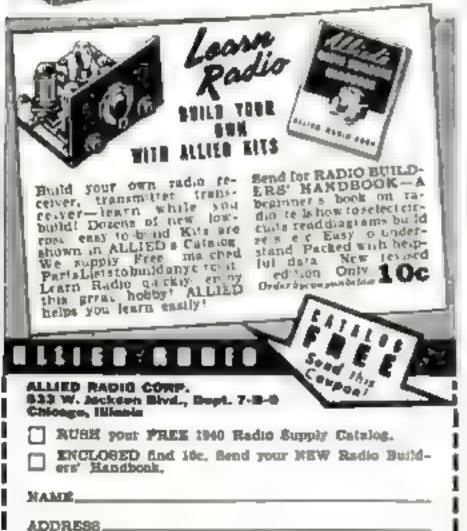
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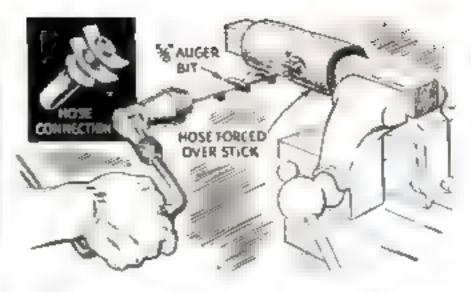
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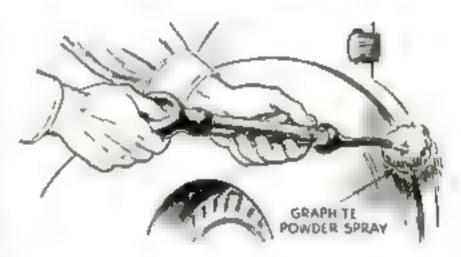
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Wooden Core Simplifies Drilling Hole in Hose

Holes for hot-water car-heater connections can easily be made in radiator hose by pushing a piece of wood into the hose as shown above, and then drilling with a wood bit of the proper size. The wood should be thick enough that the bit tip will not penetrate the opposite side of the hose.—W. E. L.



Battery Hydrometer Used as Graphite Spray Gun

AN OLD bulb-operated hydrometer, or battery tester, makes a good spray gun to apply graphite for lubricating purposes to metal joints, locks, or hood webbing on a car. Remove the float and clean the battery tester with sods or some other alkaline agent to neutralize any acid that may remain. Rinse it out with clean water, let it dry, then fill it part way with graphite powder.—R. J. H.

Temporary Hose Repair

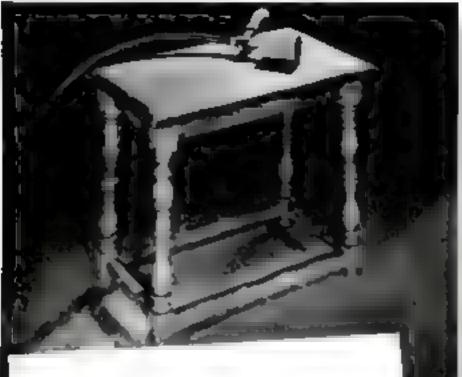
To Make an emergency repair on a leaking radiator-hose connection, cut a long strip about an inch wide from an old inner tube, and wrap the strip in a spiral around the leaking section, applying some tension as you make the wrapping. Then wrap this spiral with adhesive tape, working back over the section in the opposite direction. The tape itself thus is kept from getting wet and losing its adhesive properties.—S. R.

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A Carborundum Brand Garnet Abrasive Sleeve fitted to a drum rotated by flexible shaft becomes, if anything, even more useful than a disc sander.

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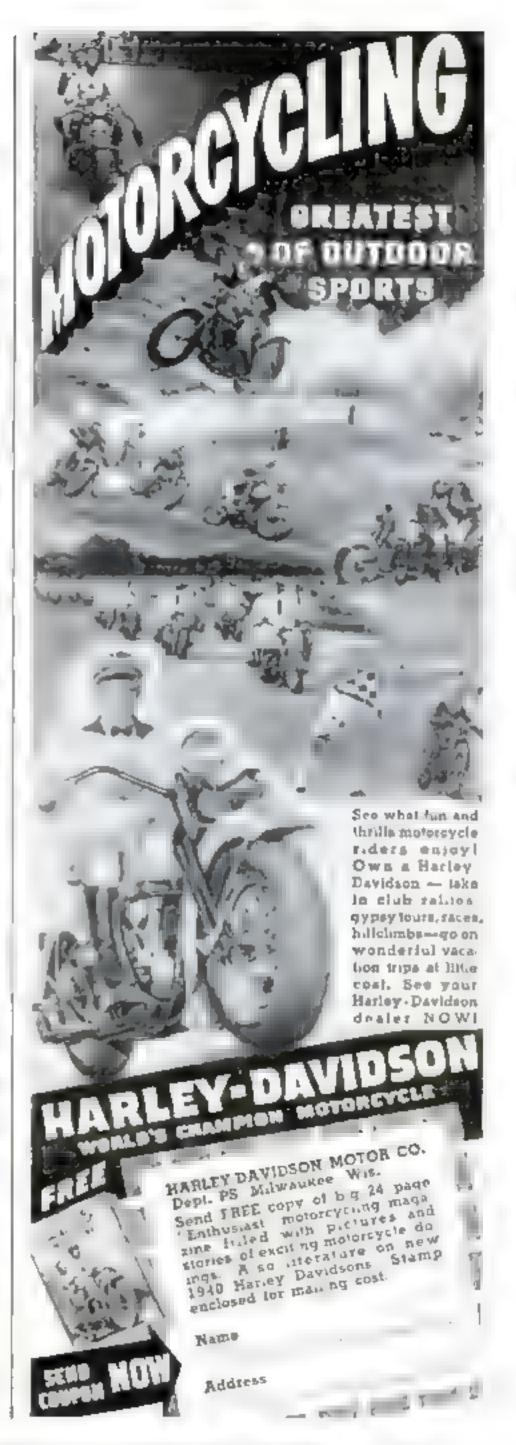
Blueprints for many other projects are available. A few of them are given below; a complete list will be sent upon receipt of a stamped, self-addressed envelope.

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Cabin Cruiser, 17' long, for use with outboard or inboard drives, 356-357-358-359-R	1.50
Camper's Utility Boat, 11' 2" long, canvas-	
covered, for outboard motor or rowing, 281-R	.50
Canoe, 15' canvas-covered kayak; can be used	
with salt, 192-193-194-R	
CBnvss Covered Duck Boat, 18' 6" long, 279-R	50
Family Runabout, 13' 5%" long, weight 275 lb.,	
for outboards from 1 to 60 h.p.; can also be	
rowed (illustrated above), 378-379 380	1,00
Fisherman's Outboard Boat, 9' 3" or 11' 6" long, weight 125 or 160 lb., for motors from 3 to 18	
h p.; can also be rowed, 344-345-R.	.75
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ming-dish hull, 314-R	.50
(Continued on page 997)	

Plans for Boat Builders

(Continued from page \$26)	
Bectional Rowboat, 9' 8" long, weighs 60 ib., all- wood construction; can be used with small	
outboard motor, 340-341-R.,	.75
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Double Decker Bed. 277A Early American Round-Ton Stand. 191A	25
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Magazine Ruck ladder back style 250A	23
Smoking Stand modern 258A Tea Wagon with rem, able tray and drap leaves	25 25 25 15
26" by 30" top (turning) 11 Upholatered Stool, 210A	25
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Pishing Schooner WE'RE HERE of "Captains	1 00
Courageous." 912" over all, 351-R	747
Liner QI EEN MARY 10 . bill 253	25
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(Construction kits are available for some) of these models. Turn to page 230	
MISCELLANEOUS	
Bahy's Cr.b and Play Pen. 26	25
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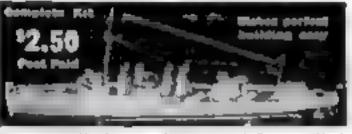
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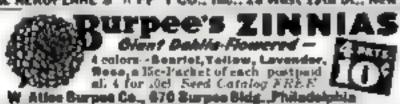
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A MODERN toolmaker should have a pocketsize microscope of his own. It's the only way to keep in step with the inspector.

I don't quite understand why some machine shops still rebabbitt certain machine-tool bearings every three or four weeks when a pair of radial-thrust ball bearings cost so little, compared to lost time and the setback in production.

If hen permissible, you can do a much better job of threading with a die, either free-hand or in a lathe, if you turn \(\frac{1}{2} \)" of that end of the stock to the root diameter of the die thread. You thus get a square start, and the turned tip can then be cut off.

Ever hear of making a coil spring from cast iron? Well, it is claimed it can be done with a recently developed gray iron that has a variety of uses and can be easily hardened.

We are told that automobile-body designers first build up models of clay, plaster of Paris, and wood before making the final drawings. I know some tool and machine designers who would save the "boss" plenty if they did the same thing.

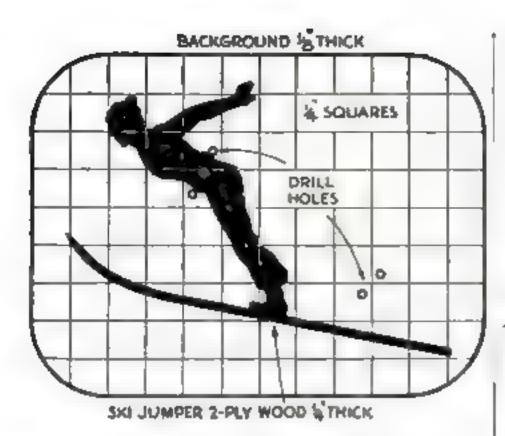
Threading dials are one of the most practical additions to lathes in years. You can readily make one for an old model lathe, and you'll enjoy both making and using it.

Each time you drill a 2" hole into a 6" length of 3" cold-rolled or carbon steel, approximately 5 lb. of material goes to the chip pile. Add the labor costs and then look at the price list of scamless steel tubing.

Old Auto Mats Reduce Fatigue in the Shop

At Garages it is often possible to obtain discarded felt-backed car mats. After the worn spots have been cut out, there is usually a piece left that is large enough to throw on the floor in front of a lathe or other much-used machine. Such a mat is restful to a mechanic who is constantly on his feet.—ALLEN ZERBE.

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Small Wooden Ski Jumper Ornaments a Snow Suit

With a ski jumper as the design, this little plaque makes an excellent gift for a sportloving friend. It can be sewn on the breast pocket of a ski suit and the name of a club added in small painted letters. In sewing, use bright colored thread to represent a belt.

Cut the background from "" whitewood and paint it, if desired. Make a two-ply board of the same material with casein glue and leave in a press overnight. Trace the ski jumper on the plywood and jig-saw it to shape. Glue the figure on the background with cellulose household cement or other quick-drying waterproof glue and place a weight on it until dry. Round off and carve the figure slightly by hand or with a dental burr held in a chuck. If the latter is used, a speed of 1,700 to 3,000 r.p.m. gives good results. Drill holes as indicated and finish with two coats of spar varnish.—EDWARD B. FOX.

Office Envelope Moistener Made from a Test Tube



IF A TEST tube is filled with water and covered with a piece of chamois skin as shown, it makes an excellent envelope moistener for office use. We had previously been using commercial moisteners consisting of a glass tube pinched at the end and fitted with a piece of felt. It always took a little time for the felt to become saturated, and the moisteners were hard to fill and keep from leaking. The homemade type has neither of these objections.—Duane W. Bailey.

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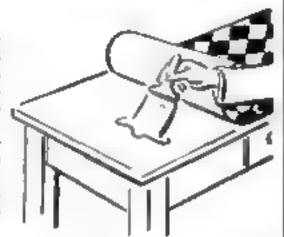




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	(Continued on page 232)	



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power tools, It explains the advantages of "diamond-boring" of bearing seats, "pre-loading" and correct mounting of ball bearings and "sealed-for-life" ball bearings. It illustrates many hidden features of design and construction that make for long, better service in power tools. It takes up the major power tools one by one and analyzes various types of design and shows the advantages and disadvantages of each design. It shows you the features you should look for in selecting power tools for your shop. Truly this new 1940 Delta Catalog is A BUYER'S GUIDE—crammed with useful information that every craftsman should have. Send the coupon for your IREE copy (also send 10c for the new Project Book No. 6, containing working drawings and instructions for many new and "out of the ordinary" things to make).

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(Continued from page 250)

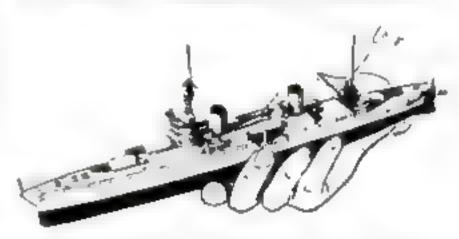
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Kit H contains all the necessary raw materials for making this 12" model of the "Indianopolis"

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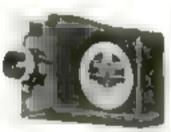
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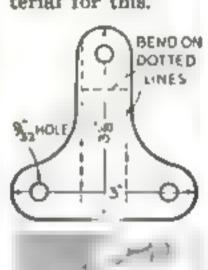
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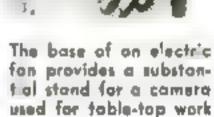
Fan Base Holds Camera for Table-Top Shots

For table-top photography, a substantial tilting support for the camera may be obtained by using the base of an electric fan. The camera is mounted with a piece cut and shaped as shown.

A nickel or chromium-plated auto radiator shell, obtained at any junk yard, provides good material for this.



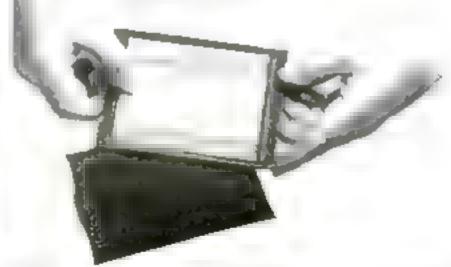




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given a matte black color, although for clearness this is not shown.—O. B.



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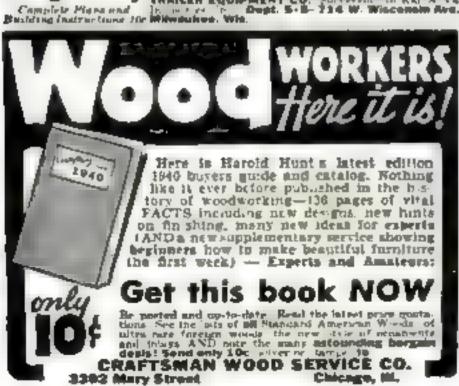






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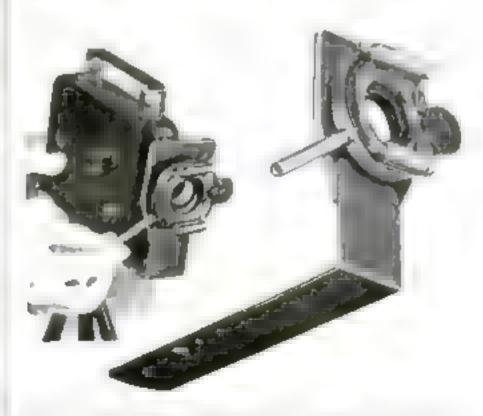
Oiled-Silk Cover Keeps Hypo Free of Dust

WHEN a tank containing fixing solution is left uncovered, it rapidly accumulates a sludge of dust particles, which may cause spots on prints or films. To keep the hypo clear, provide the tank with an oiled-silk cover having an elastic band around the edge, such as those sold for slipping over dishes of food .- OLIVER BANDELIER.

Old Camera Diaphragm Fades Movie Scenes

AMATEUR movie makers can easily make fade-ing and fade-outs by mounting the diaphragm from an old camera on a piece of band iron as shown below. A hole is drilled for the tripod screw to enable the device to be held firmly between the camera and the tripod top. A short rod attached to the diaphragm indicator facilitates its operation.

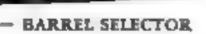
In use, the camera motor is started and the diaphragm opened moderately fast for a fade-in. The procedure is reversed for a fade-out,---WALTER HOAG.



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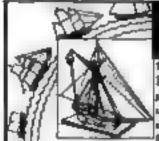
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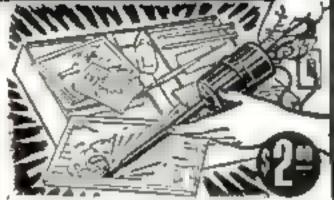
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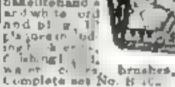
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The Making of an Army Flyer

(Continued from page 124)

Even swank colonels with eagles on their shoulders had to come in for regular drill in navigation and blind flight.

The cadet in the jeep was having trouble with his turns. The indicating wheel was tracing a snake track as he tried to straighten his course.

"A fellow ought to be able to fly a simple compass heading," criticized Sanders. He had owned a small cabin monoplane at twenty and felt himself an old hand at flying.

Ryan gave him a sidelong glance. "Ever

fly under the hood?"

"No, but anybody who has had twenty hours in the air should be able to make ninety and 180-degree turns with his eyes shut. If you keep your ailerons even, it's just like steering a bobsled, only you move your feet the opposite way. What's hard about that?"

The plane leveled itself, the hum stopped, the hood lifted, and "Chubby" McElroy's round head emerged from the cockpit. He mopped a pink face with a handkerchief as he stepped down.

"What's the matter, Lindbergh? Didja

get lost at sea?"

"Corrigan, you mean," corrected another cadet. "He started for Philadelphia and landed in a duck pond west of Cincinnati."

"All right," cut in the instructor. "Put 'em back in the hangar, you barracks pilots. Who wants to start on his jeep time?"

"C'mon, Sanders," urged Ryan, with suspicious enthusiasm. "Show the rest of us dodoes how to do it."

Sanders grinned confidently, swung a long leg over the cockpit, dropped into the seat: and pulled the "ignition" switch. The fan in the front of the fuselage sent a brisk breeze whistling past his ankles. He clamped the headphones over his ears, swung the hood down tight, and the group at the table heard his "Ready!" from the instructor's headphones.

"Climb to 2,000 feet and make a ninetydegree turn to the left," said the instructor.

The jeep's elevators lifted, the nose pointed upward; the hum of the blower increased. Then soon the jeep leveled off and began to edge to the right as the rudder bent slightly.

G Flight's instructor turned to Rick. "Jones, if he makes a one-needle turn at 130 miles an hour, how long will it take him to turn ninety degrees?"

"Thirty seconds, str."

"Right. Watch your clock, Sanders." (Continued on page 241)

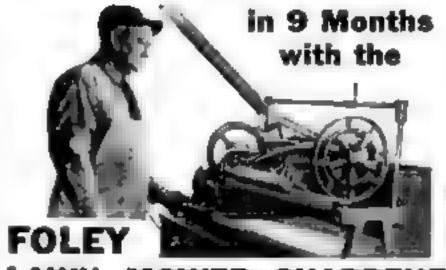


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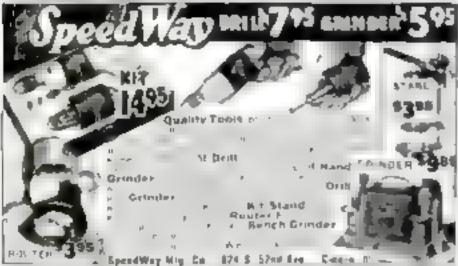
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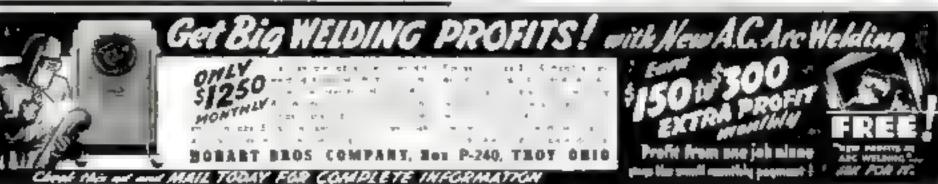
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The Making of an Army Flyer

(Continued from page 239)

By now the indicator had traced a square turn on the chart. But even as it straightened, it began to edge back again, leftward. In a moment the pilot realized his mistake and corrected it. But soon the rudder shifted back and again he was off to the left. Then, in a few seconds it made an equally wide return to the right. The indicator was tracing a curly spiral on the chart.

"He's tightening up on the turns. Now

watch this,"

Suddenly the nose jerked quickly to the left as Sanders gave an impatient flip of the rudder bar. Brought up too sharply on a turn, the jeep promptly slipped off and nosed into a spin. Around and around it went, the pilot fanning the air with the controls and vainly trying to pull out.

About the table, grins widened. The instructor bent toward the microphone. "You'll have to neutralize your controls, Sanders, . . . Keep your air speed up—she stalls below sixty-five m.p.h. . . . That's the

idea. Now pull her out."

The spin stopped, but in an instant, Sanders was off in the other direction, around and around.

"Well, make up your mind," said the instructor softly. "Are you going to fly it by instrument or by the seat of your pants?"

The jeep's controls shrugged compliance. "All right. Now pull your rudder over to the right until the compass reads 'East'."

Sanders obeyed and the jeep leveled out into even flight.

"Now how are you getting along?"

"I'm still spinning!" was the startling announcement. G Flight doubled up in allent

laughter.

"Well, guess you'd better come down if that's the case," replied the instructor. A moment later a very red-faced cadet lifted the hood. His jaw dropped as he noticed his stationary surroundings.

"Bail out, Sanders, you're going to crash!" Helpful hands reached up with exaggerated sollcitude, to help him down. San-

ders waved his arms in surrender.

"All right, all right, I give up! So far as I can see, I'm still in a spin, but I guess maybe those instruments know what they're talking about. Maybe a bobsled is a better proposition for flying by the seat of the pants than an airplane, after all."

Next month, Sterling Gleason will tell how Rick Jones completed his training and received his wings as a full-fledged Army flyer.



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600 Miles an Hour in the Air

(Continued from page 104)

heavily in the reduction of this variety of drag.

Rivets, for example, High-speed wind-tunnel tests have shown that the usual number of 3/32-inch brazier-head rivets in a metal wing increase its drag by twenty-seven percent if they are exposed, but increase it by only six percent if they are countersunk. Spot-welding causes even less drag, provided that the depressions at the welds are kept as shallow as possible. Conventional Japped joints are responsible for a nine-percent increase in wing drag, but if the joints are joggled they cause only four percent more drag than a perfectly smooth wing. Manufacturing irregularities, such as waviness in the metal sheets and joint imperfections, cause an eight-percent increase in drag. Paint sprayed on the wings of a certain plane increased its drag at 225 miles an hour by fourteen percent.

In their desire to increase the speed of airplane flight, scientists haven't lost sight of the necessity for increasing their safety. Continuous investigations are conducted with the purpose of making it possible for designers to produce planes with improved

stability and control.

Many experiments for this purpose are made in the twelve-foot, free-spinning wind tunnel at Langley Field. Models are launched in a tail spin in the rising air stream. After the spin has fully developed, a clockwork mechanism in the model sets the controls for recovery and the model's action is recorded by a motion-picture camera. These tests make it possible, before a plane is built, to determine whether it will be controllable.

Until a few years ago, the United States was the world's undisputed leader in aeronautical research, but since 1935 the emphasis placed on flight investigation by Germany and Italy has enabled them to catch up with us and perhaps forge ahead of us. Germany has a 600-mile-an-hour, full-scale wind tunnel at the great research center at Adlershof—Eaglecourt—which employs four times the personnel of our Langley Field laboratories, and has three other major research centers. Italy also has a marvelous laboratory in Guidonia, a new city devoted entirely to aeronautical research. With the appropriation by Congress of \$10,000,000 for a new N.A.C.A. flight laboratory at Sunnyvale, Calif., to supplement the work being done at Langley Field, Uncle Sam is making a new bid for military and commercial supremacy in the air.



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Gus Shockproofs a Car

(Continued from page 144)

a steady one. Very much obliged to you." Joe Kent, an out-of-town salesman who waits, whenever he can, until he gets to the Model Garage to have his repair work done, was the next caller. "I don't know what's the matter with this bus of mine," he complained. "It's running all right, but it burns up almost as much oil as it does gasoline. I've lost almost two quarts in a hundredmile run today

"I've got a few calls to make in town, and I'd better make them now," Kent said. "Til come back when I've finished. But I wish you'd take a look at my windshield wiper right now. It isn't working well, and it's

starting to rain."

Gus looked the wiper over and then disconnected the vacuum line at the manifold. Then he grinned. "Guess I brought down two birds with one shot," he said, "Your vacuum line is filled with oil-that's why your wiper doesn't work right, and also why you are using so much oil. The diaphragm of the booster pump that makes the wiper work at a uniform rate of speed is broken. and the oil is being drawn right into the intake manifold. I'll connect your wiper direct to the manifold now, so it will work all right for this afternoon. When you bring the car back I'll put a new diaphragm in the booster pump, and your oil trouble will be over."

After Kent had driven away Joe Clark came into the shop to collect time and material slips. He frowned as he glanced over the sheaf of them that Gus handed him. "All little picayune jobs," he grumbled. "Well, that's the way in the garage business—just one darn thing after another."

"Sure," Gue said. "That's why I like it."

POPULAR SCIENCE Question Bee

ALL RIGHT, let's see how well you came out in the Question Bee on page 140. The letters in the list below indicate the correct answers to the numbered questions. Check your results with the list and give yourself five points for every one you had right. A total score of 75 to 85 is good, and 90 or better is excellent.

1.	c	5.	d	9.	b	13.	C	17.	a
2.	b	6.	8.	10.	Ъ	14.	C	18.	C
3.	b	7.	c	11.	C	15.	С	19.	b
4.	d	8.	d	12.	b	16.	d	20.	b

Thie One DFYA-629-6QHW

Table-Top Oil Refinery

(Continued from page 211)

gone well, you will find that the oil has thickened considerably or has actually turned solid-depending on the degree of activity of your homemade catalyst, and other conditions in carrying out the experiment.

You can make your product a little purer by filtering it, while hot, through a pledget of absorbent cotton placed in a funnel. This removes the nickel catalyst mixed with it. Both the oil and the funnel must be warm during this filtration, or the oil will harden in the funnel and refuse to flow.

Another oil that lends itself to homechemistry experiments is the oil from the seed of the flax plant, or linseed oil. Used in making paints, linoleum, printing inks, and putty, linseed oil has the unusual ability to combine with the oxygen of the air and form a stiff, rubberlike film. The thick scum or skin that you see on the surface of paint in a can is a film produced by the oxidation of linseed or other oils of the paint, forming compounds that are termed linexins.

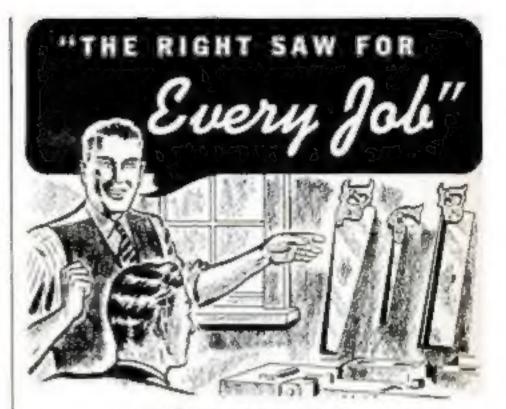
You can easily show how such an oil combines with the oxygen of the air, and at the same time demonstrate the first step in the manufacture of linoleum. Cut several pieces of cotton cloth, an inch or more wide and six or eight inches long. Hang the strips vertically in a warm place, with a noncombustible tray beneath them. Pour linseed oil over the strips, letting it trickle down and saturate the cloth. To each fluid ounce of the linseed oil that you apply, there should previously have been added several drops of a liquid drier (a metallic resinate or borate), which may be obtained at any paint store. The drier acts as a catalyst to speed up the oxidation of the linseed oil film. At the end of several days or weeks, the cotton strips will be so stiff that they can be held horizontally by one end without drooping.

By repeated treatments of this kind, the cloth may be given a thick layer of oxidized oil or linoxins. In making linoleum, such strips are prepared in warm buildings; the strips are ground; gums, resins, coloring pigments, and cork dust are added; and the whole is fabricated into sheets of linoleum

for your kitchen and other floors.

Linseed oil also combines with sulphur, as do other vegetable oils, notably rapeseed oil. A rubbery product is the result. Try heating a tablespoonful of linseed oil with a pinch of ordinary flowers of sulphur, stirring until the sulphur has melted. The mass can be drawn out like rubber and even has the odor of rubber. Under the name of "factice," it is used as a rubber substitute.

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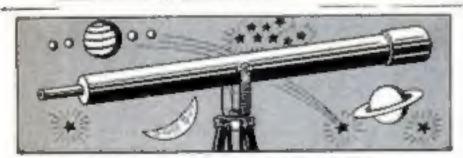
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Your Microscope Reveals Secrets in Stone

(Continued from page 208)

more complex, but the beautiful results obtainable with most rock materials will justify the effort. It may sound strange to talk about sections of rock thin enough to transmit light, but even the blackest, densest rock, when reduced to a thickness of 1/1,000" or so, will pass light, and even permit print to be read through it. In this state it makes an excellent subject for microscope study. Much of our present-day knowledge of rock structure was made possible by such thin sections.

At first, you will find it best to select some crystalline material such as a piece of granite, for the reason that the various minerals (quartz, feldspar, etc.) are beautifully differentiated in polarized light.

Take a fragment of rock that is flat and rather thin, and coment its flattest surface to a piece of sheet mica, say one measuring %" by 1", with hot balsam. Place a drop or two of balsam in the center of a glass slide and heat it gently over a Bunsen or alcohol flame. Do not heat it enough to cause violent bubbling. After a minute or so, let the balsam cool. If you can dent it easily with your finger nail, it requires a little more heating. If you can barely make an impression in it, it is about right. If the heating is carried too far, the balsam is brittle, and some unheated balsam must be added to restore the solvent.

After the finger-nail test indicates that the balsam is right, remelt it and cement the rock fragment to the mica plate. Then fasten the mica to the slide. The purpose of this mica plate will become apparent presently.

For grinding the specimen flat and polishing it, you will need abrasive stones of several degrees of fineness. A workable combination consists of a coarse-grained stone, say a piece of sandstone of the type used for making grinding wheels or grindstones, and a two-faced razor hone. Keep the stones wet while you are grinding the section. A hose arranged to give a steady flow of water across the face of the abrasive stone is excellent.

First grind the specimen flat and reduce it to the thickness desired, on the coarse abrasive surface. Next use the coarser side of the razor hone, and finally polish it on the finer side of the hone. Use straight back-and-forth strokes. Rocking that produces a convex surface on the specimen can be reduced by cementing, with balsam, two

(Continued on page 247)



